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Popular Science

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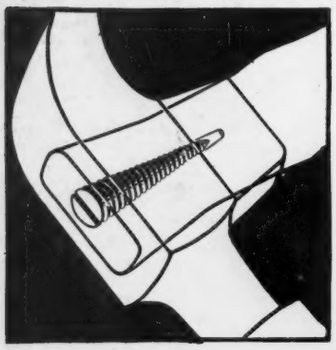
INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP

SEPTEMBER

Giant plane designed to cross Atlantic in a day

25 CENTS

$10,000 Prize Contest—See Page 31



Instantly, with a turn of the wrist, you retighten the head of any Plumb Tool. V-shape of wedge expands wood of handle against all sides of eye all the way in.

Look for the
Red Handle
with the
Black Head
(Color Combination registered as trade mark in U.S. Patent Office)
EXCLUSIVELY
PLUMB

Black head on red handle means a better hammer

SEE what PLUMB has done to give particular tool-users a hammer they will appreciate.

A hammer, too, that will retain its good qualities through a lot of hard use.

With its larger face, for accuracy;
Its shorter neck, for better balance;
Its claws improved in pulling power;
Its head specially tempered—hard for service, tough for wear—
AND THE TAKE-UP WEDGE TO KEEP IT NEW.

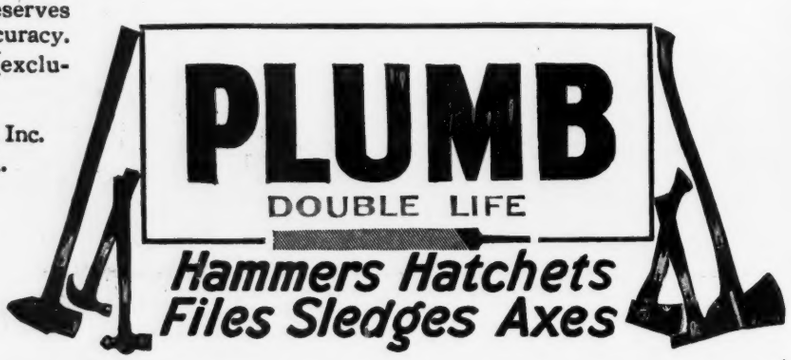
The Plumb Take-Up Wedge retightens the black head of this hammer with a turn of the wrist. It keeps all Plumb heads tight on Plumb red handles.

The Take-Up Wedge preserves balance and hang and accuracy.

It keeps Plumb tools (exclusively) good as new!

FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

The PLUMB Balanced Nail Hammer At good hardware stores $1.30 (except in Far West and Canada)



Startling! Revolutionary!

These new developments of Powel Crosley Jr.

This compact, efficient receiver is an improvement of the famous Crosley one tube set, with which Leonard Weeks, of Minot, N. D., heard the MacMillan Polar expedition while the rest of America listened in vain.

The employment of the double circuit not only reduces radiation to a minimum, but radically improves selectivity. It can be tuned through local stations more readily. Under average conditions, its radius, with head phones, is 1500 miles or more.

You can use the "PUP" to check the performance of your larger set; to entertain that youngster whose curious fingers cannot resist the lure of dials and switches; to install in the maid's room, or even your office—for the air is full each day. You can take it on canoe trips, picnics, outings, and on your business journeys—for it's only half the size of a shoe box.

It is not offered as superior to the higher priced sets. There *is* a difference in volume of sound—but *no* difference in receptivity, selectivity, tonal qualities—or the enjoyment it offers.

The Crosley "Pup" is offered as a real selective, long distance receiving set. It requires one dry cell, one "B" battery block, one WD12 tube, a pair of head phones and antenna.

The CROSLEY Pup $9.75 WITHOUT ACCESSORIES

A Genuine Armstrong Regenerative double circuit receiver

Crosley owns and operates Super-Power Broadcasting Station WLW

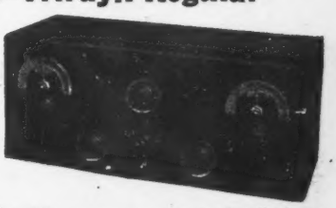
New CROSLEY Super-TRIRDYNS for 1926

3 Tubes Do the Work of 5 or 6

You have not heard the perfection of radio reception until you have listened to these two new Super-Trirdyns. In them the need for more than three tubes is eliminated by the famous Trirdyn hook-up—which combines tuned radio frequency, Armstrong regeneration and reflex amplification. There is no radiation. Distant stations come in clear and sharp on the loud speaker and can be accurately logged. Offered in solid mahogany cabinets of exquisite beauty and design, these new models are the aristocrats of radio reception at democratic prices.

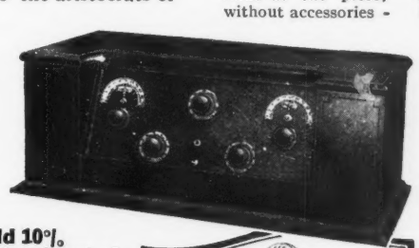
The New Super-Trirdyn Regular

A beautiful cabinet job! Simple, yet rich. Oil rubbed solid mahogany. Art metal dials give distinctive finishing touch. With new Trirdyn features incorporated it is a wonderful value at the price, without accessories - **$50**

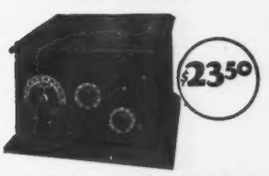


New Super-Trirdyn Special

The finest development of the famous Crosley Trirdyn—beautifully done. A magnificent cabinet of solid mahogany—simple in design. Richly finished with engraved metal dials. The case is large enough to contain all needed batteries if dry cell tubes are used. Price, without accessories - - **$60**



Radical Improvements in Other Popular Crosley 2 and 3 Tube Models!



$23.50

New 2 Tube—51 Special Deluxe

These low priced models represent radical improvements in selectivity, performance, appearance *and value*. More selective control and improved receptivity have been achieved by the use of the new worm type tickler, the new Crosley vernier plate condenser and the double circuit. Price without accessories.

New 3 Tube—52 Special Deluxe

This model like the 51 contains the new Crosley improvements and represents also as the 51 new beauty in finish and appearance. Room for dry cell batteries in both models. Price is without accessories.

$32.50

The MUSICONES
An Improved Loud Speaker

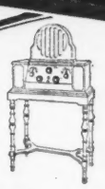
Musicone De Luxe

The Musicone has been artistically combined with a clock case of beautiful mahogany with a grilled screen. Price **$27.50**

Add 10% to All Prices West of Rocky Mountains

It is expected that no less than 500,000 present day "loud speakers" will be replaced by the Musicone in this, its first year. The Musicone reproduces the full tonal range of the human voice and music without distortion, over tones, resonance or chattering. It requires no adjustments nor additional batteries. The patented actuating unit is the secret of its faithful reproduction of all tones. Not the mere cone. Beware of imitation cone speakers. Covered by basic patents. Price

$17.50



TRIRDYN
Combination De Luxe

The new Super-Trirdyn Special De Luxe Combination designed by Crosley and built by Crosley cabinet workers. It consists of a handsome solid mahogany table, the Super-Trirdyn Special (batteries self contained) and the Musicone De Luxe. Sold separately if desired. Table $25. Musicone $27.50. Combination - - - **$112.50**

THE CROSLEY RADIO CORPORATION Ⓢ

Crosley manufactures receiving sets which are licensed under Armstrong U. S. patent No. 1,113,149 and priced from $9.75 to $60 without accessories.

CINCINNATI

See the Crosley line at your dealer's ***Write for descriptive catalog***

Ⓢ **This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.**

Popular Science Monthly

The Magazine of Invention and Discovery

SEPTEMBER, 1925; Vol. 107, No. 3
25 cents a Copy; $2.50 a Year

Published in New York City at
250 Fourth Avenue

Coming Next Month

In the Wild-Animal Hospital—The remarkable experiences of a daring surgeon who has performed more than 1500 operations on lions, elephants, monkeys, and many other wild animals. A story packed full of dramatic episodes.

Long Life to Your Tires—In another entertaining "Gus and Joe" story next month, the two proprietors of the Model Garage give some valuable tips on how to take care of your tires. If you haven't met these two fascinating characters, you can make their acquaintance on page 76 of this issue.

What Radio Set Shall I Build?—That's a question many a radio fan is asking himself this fall. In an article next month our Radio Editor will help you answer it.

More than 200 other fascinating articles and pictures, giving you all the news of radio engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

Repairing the broken leg of an ape—one of many interesting incidents in next month's story of the experiences of a wild-animal surgeon, who has performed more than 1500 operations

THE world's most mysterious man is writing his story for POPULAR SCIENCE MONTHLY; one of the most fascinating in the whole wide field of science. The secrets he reveals answer questions that have been rising in the minds of most of us since childhood. Watch next month's issue, on sale September 10, for the announcement of this amazing series.

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POPULAR SCIENCE MONTHLY

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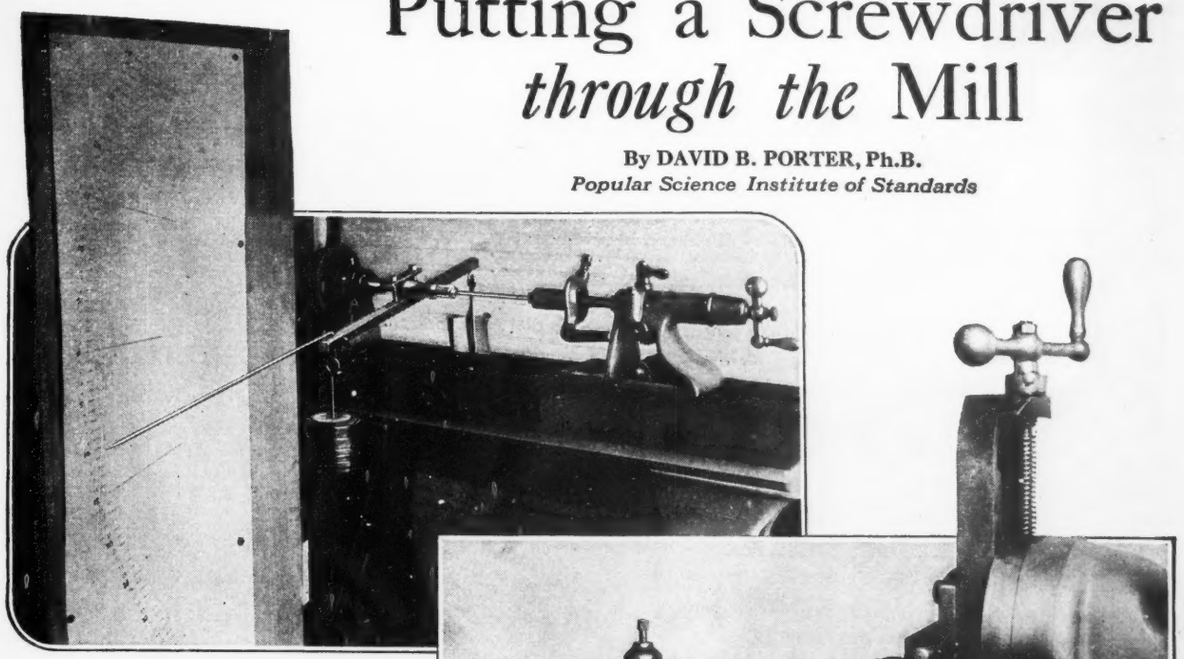
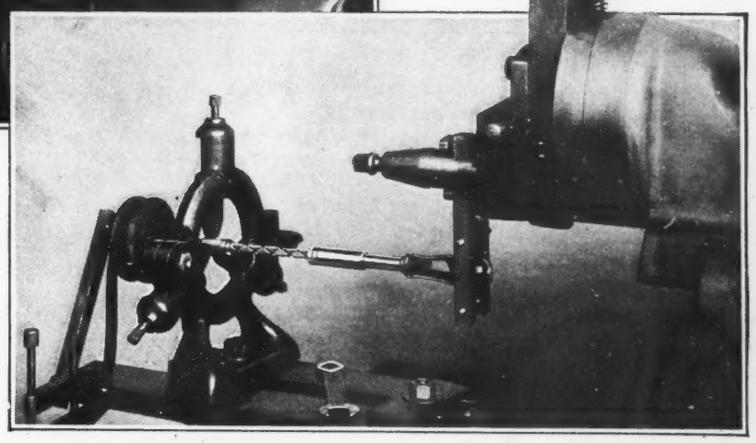
O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

Putting a Screwdriver *through the* Mill

By DAVID B. PORTER, Ph.B.
Popular Science Institute of Standards



Here a screwdriver is undergoing the "torsion test," which determines the degree of toughness of the blade. A weighted arm is clamped to the screwdriver handle. Angular deflection on the chart indicates blade resistance



The wearing qualities of the spiral mechanism of this ratchet screwdriver here are subjected to a test in a few hours that equals many years' ordinary usage

THE screwdriver is perhaps our simplest tool—so simple, in fact, that its misuse is mastered readily and we sometimes wonder if it is not *mis*used more than used.

When some ice is wanted, and the pick has rolled under the icebox, the feminine members of the family invariably seize upon the screwdriver and hammer. Or, when that new piece of furniture arrives firmly crated with stout nails, the screwdriver again is resorted to with the hammer following it up. This time it is not only used as a crowbar, but tried out as a cold-chisel when some misdirected blows drive the edge half through a nail.

In devising tests for screwdrivers, it is obvious that the Popular Science Institute of Standards can consider only the legitimate uses for which they are designed. But, as our tests have proved, there are any quantity of screwdrivers on the market that will not stand up under even normal usage. Such screwdrivers (as well as other tool and radio products that do not pass the Institute's tests) cannot be advertised in POPULAR SCIENCE MONTHLY.

THE chief requirements for screwdrivers are that the blades be sufficiently hard to resist wear and prevent rounding corners, and tough enough to turn the screw without being twisted. There is a limit, however, to the degree of hardness, because brittleness also increases with the hardness and a blade that is too brittle soon breaks at the corners.

The degree of hardness is measured by the scleroscope—an instrument that has had very wide commercial use in testing the hardness of steels. From the results of such tests, it is possible for the engineers of the Institute to tell whether the blades have the right degree of hardness.

The toughness of the blades, or their ability to resist twisting, is determined by our "Torque Test," which is illustrated at the left of the page. An arm is clamped to the screwdriver handle and successive weights are applied. For each weight the angle of twist is read on the scale behind the pointer, and from this the load in pounds-inches is determined. The angular deflection on the chart tells instantly how the steel of the blade is acting as the load increases. The torsion applied in this test exceeds that which could be exerted by the strongest mechanic.

In the case of the spiral ratchet screwdriver it is necessary to go further than a test of the blade, and to determine the wearing qualities of the spiral mechanism. By use of ingenious tests devised by the engineers of the Popular Science Institute of Standards, it is possible to give this mechanism many years' wear in a single afternoon.

THE illustration on the right shows how this is done. The tests are carried out on a shaper, the traveling head of which gives the reciprocating motion needed to produce the kind of wear that would develop any defects in the mechanism of the tool. Exact measurements are made of the amount of wear occurring in the spiral mechanism. The pressure against which the reciprocating head works has been predetermined by establishing the pressure exerted by a mechanic in driving a screw into an oak block.

In addition to the above tests, the screwdrivers are inspected for finish and workmanship, the handles for security, and ratchets and locks are carefully tested to see that they function easily after the screwdrivers have been subjected to further severe torque and wearing tests.

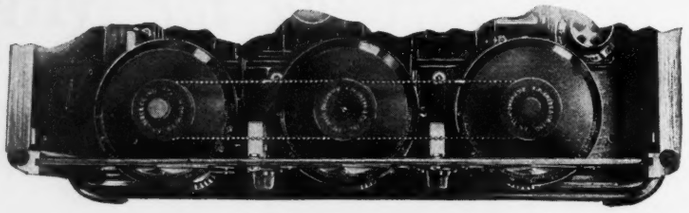
Send for List of Approved Products

POPULAR SCIENCE *Monthly* Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

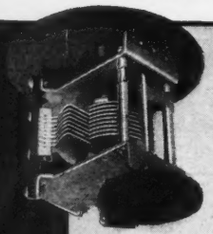
THE PUBLISHERS.



Another exclusive Grebe feature: One dial can operate all three—or they can be set separately at will.

Again Grebe steps ahead—

The Synchrophase now has One, Two or Three-dial Control



S-L-F Condenser

THE three condensers operate from one dial—or separately at will. This first real, flexible form of "unit-control" marks another milestone on the road of Grebe leadership.

The new Synchrophase has the same *Binocular Coils* which give that unusual "selective sensitivity" so universally prized; the same Straight-Line-Frequency Condensers that make accurate tuning easy.

Ask your dealer to demonstrate; then compare

A. H. Grebe & Co., Inc., Van Wyck Blvd., Richmond Hill, N. Y.
New York Office: Steinway Hall, 109 West 57th Street
Western Branch: 443 So. San Pedro Street, Los Angeles, Cal.

This company owns and operates stations WAHG and WBOQ; also mobile and marine low-wave rebroadcasting stations.

GREBE SYNCHROPHASE

—TRADE MARK—
REG. U.S. PAT. OFF.

"Get rid of small wisdom and great wisdom will shine upon you."
Chuang Tzu

It is great wisdom to buy the Synchrophase.
Doctor Illy

GREBE RADIO
TRADE MARK
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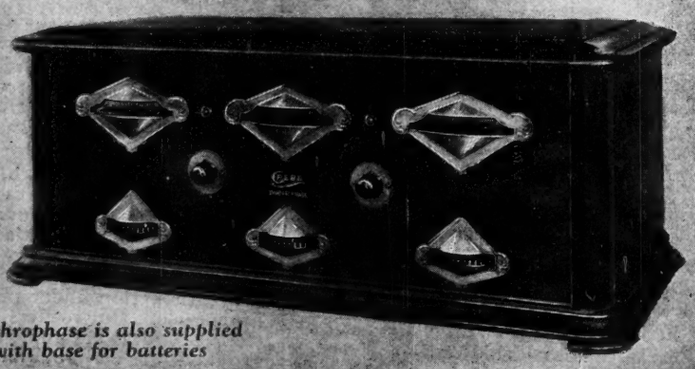
All Grebe apparatus is covered by patents granted and pending.



Synchrophase is also supplied with base for batteries

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
September, 1925

Cracks in the Earth Menace Big American Cities

Scientists See the Need for More Widespread Knowledge of Earthquakes and Their Causes

By Arthur Selwyn Brown, Ph.D., LL.D.

ABOUT the last thought, probably, that occurs to the average American is that he may be living in an area of earthquake danger. It is only following disasters such as the recent ones in Santa Barbara, Calif., and Montana that people in this country realize that earthquakes are phenomena not confined exclusively to the more remote regions of the earth.

As a matter of fact, earthquakes occur in the United States every year—many of them. More than that, they occur in places that point to the existence of definite lines of earth weakness passing through or near some of our greatest cities. New York, Washington, and Boston, for example, lie along one of these lines, and consequently are not entirely removed from the danger of earthquake.

Other similar lines are found stretching across the continent from southern California to the Atlantic Coast, sweeping up through the Mississippi Valley to the Great Lakes, and cleaving the center of New England. Within these areas live millions of people.

To alarm them is not my intention. What I wish to do is to call attention to the pressing need of an intensive seismological survey of the United States and Canada—a work that too long has been neglected because its importance has not been foreseen.

There is need, too, for our architects, engineers, and builders to develop proper foundations and earthquake-proof houses for regions where earthquake dangers exist. It is the ground, not houses, that moves, and resilient houses would usually not be injured by an earth tremor. A severe shock in any of the cities that lie along the faults or lines of earth weakness in this country would have most calamitous results with buildings of the existing type.

A few far-sighted men have recognized this danger. Thus, almost immediately following the Santa Barbara earthquake, the owners of one of New York's most famous skyscrapers obtained a large insurance policy against possible damage to the building from earthquake.

Seismologists have, during the past 10 years, given attention to the world's principal volcanic zones. They have mapped the areas where the most numerous and pronounced earthquakes are recorded. These show that there is a line of weakness encompassing the earth, starting in the Aleutian Islands and running through Alaska to California, Mexico, South America, the south polar continent, New Zealand, Tasmania, the east coast of Australia, Japan, and thence northward to the Aleutians again.

THERE is another belt around the Mediterranean, running to Persia and thence northward to Nova Zembla and the North Pole. The Mediterranean belt is linked with the Pacific belby a zone traversing the northern portions of South America and running under the Atlantic to Morocco. Another line parallels this to the north. It runs through the Caribbean Sea, across the Atlantic to Great Britain and then along the Norwegian coast until it connects with the Asiatic line passing Nova Zembla.

A study of the annual reports of earthquakes in the United States plainly shows that there is also another important line of weakness starting in the southern parts of California, traversing Arizona, following the thirty-fifth degree of latitude, sending a spur up the Mississippi and Ohio rivers, then running eastward to the sea, and thence following the coastal ranges up to Prince Edward Island and Newfoundland.

Another line of weakness in North America may be found in Canada. The Great Lakes and the St. Lawrence were formed along fault planes that are still lines of volcanic weakness. The activity of the Saguenay fault in the St. Lawrence River is well known. It is

Santa Barbara's Ruins

State Street, the main street of Santa Barbara, Calif., a few hours after the recent terrific quakes hurled masses of masonry and debris from shattered business buildings into the middle of the wide streets, leaving behind a scene of destruction

not so well known, however, that a similar line of faulting is shown by the great rivers, lakes, and waterways stretching through Canada from the Atlantic to the polar seas near the Alaskan boundary. Whenever there is earthquake activity in California or in our southern and eastern states, we may be sure to find similar activity in Alberta, Saskatchewan, and Manitoba.

The influence of earth faults in developing rivers and lakes has been shown lately by seismologists who have studied the volcanic history of the eastern coast of Africa. Rift valleys containing lakes, swamps, rivers, and other water bodies run from Cape Town, through Nyanza, Taranki, Rudolph, and other lakes, to Abyssinia, where a large rift valley, triangular in shape, exists between Abyssinia and Somaliland. The Nile runs almost parallel to this East African earthquake zone, and that river apparently courses along a series of faults.

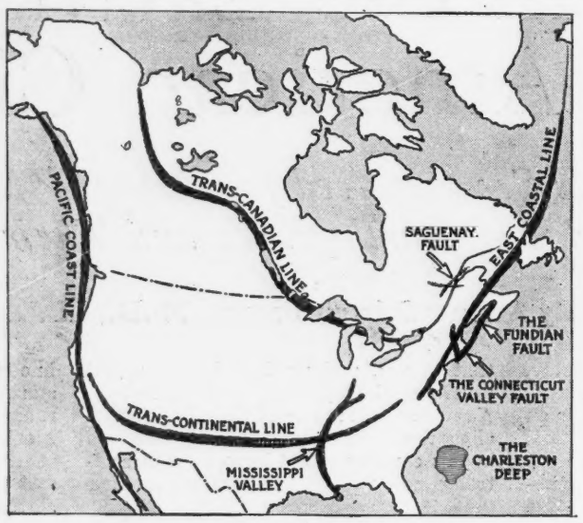
NEW YORK affords a clear case of river development by faulting. The Harlem River, which joins the Hudson and East rivers, flows through fault gorges in gneiss and limestone rocks. The dropping of large areas of rocks, just as those that followed the earthquakes in San Francisco and Santa Barbara, undoubtedly preceded the first flowing of the Harlem River. Here is one established fact showing the structural weakness of the earth in New York. The valley of the Hudson appears to follow lines of faulting also. These faults are connected closely with the rising of hills and mountains in the same or distant localities.

The earthquakes in California are along lines of faulting. They parallel the sea and the coastal mountains. In the sea are deep depressions called on the charts "deeps," which are points of earthquake activities. The majority of severe quakes in recent years have occurred along lines of weakness near one or more of these deeps. There are many such deeps in the Atlantic, off the eastern states of America, and in the Pacific, off our western coast. There is one off the Antilles; others are off Charleston, Cape Lookout, the Great Bank of Newfoundland, and the Azores, Canaries, and the Cameroons in the Atlantic. Still others are off San Francisco, Alaska, and Mexico, in the Pacific, besides many more off the coast of South America, in the South Seas, and around Australasia.

SIMILAR points that play prominent parts in disturbances in India and the Himalayas occur in the Indian Ocean, off Java, and in the Malay Archipelago. When the mountains rise, these deeps sink, indicating that earthquakes are not merely local phenomena, but are evidences of forces exerted upon the whole unstable crust of the earth.

What these forces are has not been determined. The best evidence indicates that earthquakes are caused by electrical disturbances originating far down in the earth's interior. These disturbances recur in violent outbursts about every 10 or 12 years and always are accompanied by marked changes in climate.

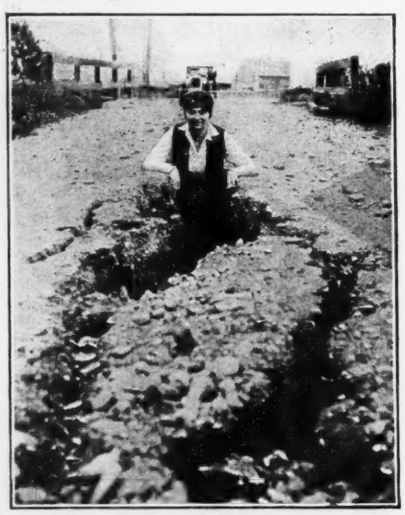
The present summer of 1925, during which the Santa Barbara earthquakes and the shocks in the eastern states and elsewhere occurred, has been remarkable for its humidity, high barometric pressures, and frequent thunderstorms and electrical displays, all over the United States.



Earthquake Belts in the United States

This map of the United States, based on earthquakes that have occurred in the past, shows the principal lines of earth weakness. Some of these pass through or near some of our greatest cities. New York, Washington, and Boston, for example, lie along one of these lines that follow the Atlantic coastal ranges to Canada

There is such a close correspondence between the periods of earthquake activity and the appearance of spots and prominences on the sun that some observers have assumed that earthquakes are caused by sun-spots. The truth, however, is that the sun-spots and volcanic activities on earth are merely evidences of the same universal forces of nature in operation.



Where the Earth Cracked

The recent severe earthquakes in central Montana opened up great fissures near the town of Great Forks, where the property damage was estimated at $500,000. The crevice shown here is 100 feet long, in some places from two to five feet wide and from two to eight feet deep

The earth carries a great weight of air. Any increase in this weight must make a considerable difference in the strains acting upon the thin crust of the earth. All who have worked in deep mines know that when there is a high barometrical pressure, the column of air in a deep shaft greatly increases in weight, and work in deep mines becomes increasingly arduous. When unusual climatic conditions occur in any given locality, there must be enough added pressure on the earth strains to cause the rupture of many weak zones that must cause a sinking, sliding, faulting, or folding of the rocks.

ELECTRICAL and magnetic forces operate in a similar manner. The earth is a large magnet surrounded by innumerable and powerful lines of magnetic force. These lines of magnetic force are surrounded by electric lines of force beginning at the south magnetic pole and winding spirally to the north magnetic pole. The rocks and molten material of the earth's interior are charged with magnetism and the earth's rotation serves to generate vast electric and magnetic currents.

Here we have a great natural dynamo constantly creating enormous electric and magnetic currents that are sent off into space to create new stars, suns, and planets.

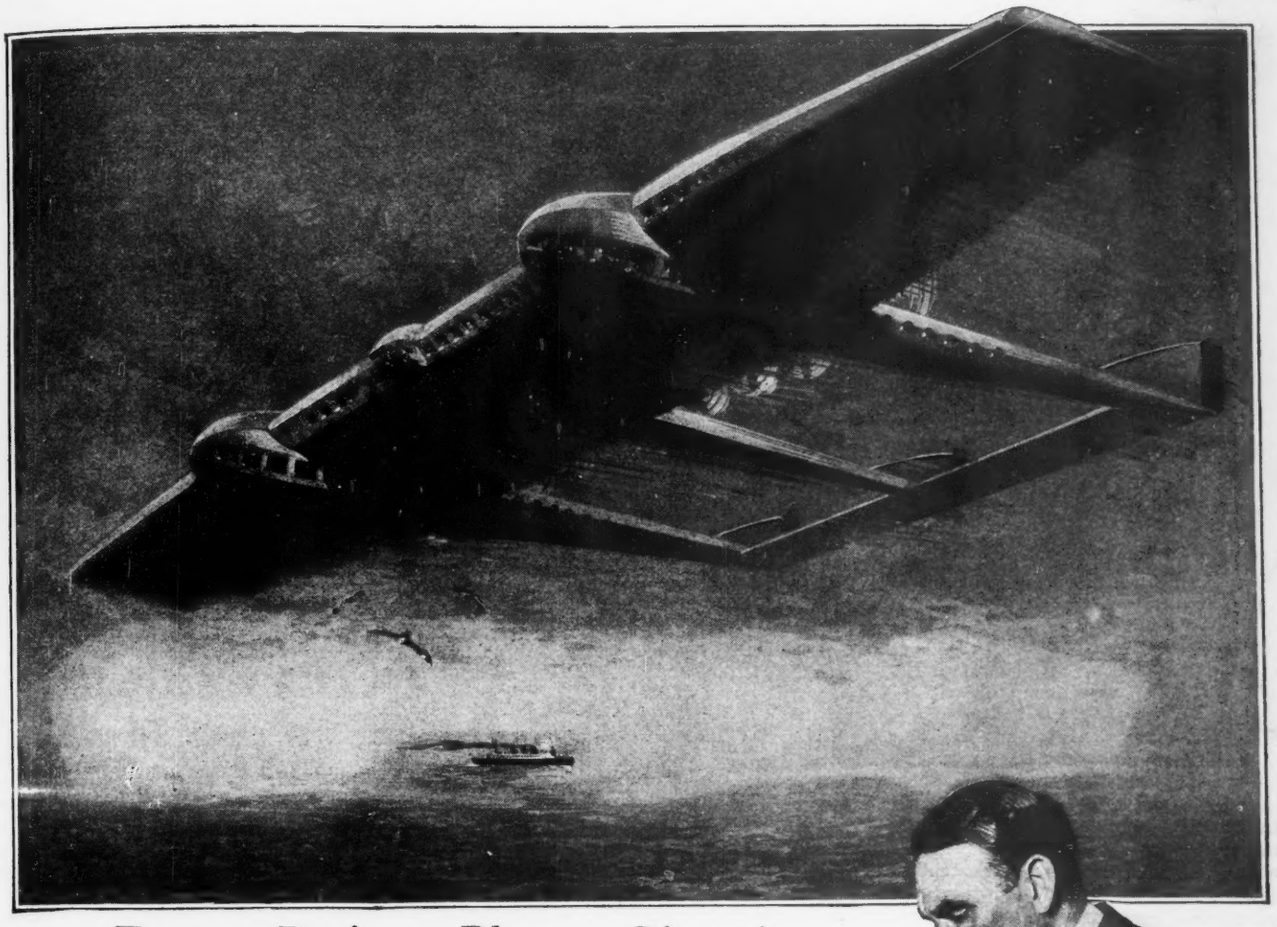
And we may view the sun, planets, and stars as acting in the same way. The sun alone sends down to the earth enough electric and magnetic energy to cause enormous disturbances in the earth's magnetic and electrical fields and to profoundly change the position of the earth's apex and intensify the strains on the earth's crust. It is electric and magnetic waves of this character, coming from the sun and other stellar bodies, or, perhaps in some cases, from electrical ruptures in the clouds, that cause the principal earthquake and volcanic activities on the earth's surface. To be able to predict earthquakes, we should have world-encircling climatic and electrical observation stations to secure data to use in conjunction with seismological and astronomical data. The study of seismological data alone will never enable us to anticipate new volcanic activities.

KNOWING that earthquakes occur in their greatest intensities along lines of earth weakness, we should study the lines of weakness in the United States so as to be able to anticipate those parts that are most likely to be visited. To simplify this work, we might sketch a map to show the principal lines of faulting and the locality where earthquake shocks are of frequent occurrence in North America.

The whole western coast, between Alaska and Mexico, is well known to be on one of the greatest lines of weakness. The Pacific bed is falling, the coastal ranges are increasing in height, and the seacoast is bearing the greatest of the compression strains. The oceans grad-

(*Continued on page 124*)

New York *to* Paris *in a* Day!



Famous Designer Plans a Gigantic Air-Liner to Carry 75 Passengers

By Truman Stevens

Louis Breguet, French airplane manufacturer, studying plans for the giant passenger plane with which he expects to establish 26-hour transatlantic service between New York and Paris. Above is our artist's conception of how the great air-liner may look

WITHIN the next five years we shall see giant transatlantic airplanes that will carry at least 75 passengers from New York to Paris in 26 hours, and at a cost less than present passage on large steamships!

This prophecy comes, not from an idle dreamer, but from a hard-headed, practical designer of airplanes, a pioneer in aviation. He is Louis Breguet, French airplane manufacturer, whose factory in Paris is said to turn out more machines on a commercial basis than any other plant in the world.

The working plans for such an air monster already have been completed, according to reports from Paris, but M. Breguet expects that the machine will not be built, tested, and ready for trial flight before five years.

On this page and on the cover of this issue our artist has pictured how the great passenger plane, as described by M. Breguet, may appear in flight over the sea. The machine will be of all-metal construction, with twin bodies, capable of alighting on either land or water. With a load of 75 passengers, freight, and baggage, it will weigh 55 tons. Power will be supplied by eight motors developing a total of about 5000 horsepower.

Luxurious passenger quarters in the two hulls and in the wings will include eight first-class cabins, 52 second-class, and 15 third-class. The first-class cabins will be six feet high, six feet wide, and 10 feet long. In addition, there will be a restaurant with electrical cooking equipment throughout, and a reading-room and lounge where smoking will be permitted.

The crew of the giant seacraft will include, besides the commander, a chief electrician and assistant, two pilots, eight mechanics, four cooks, and a wireless operator.

It has been estimated that the cost of building the plane—about $2,000,000—will be covered by receipts from 2000 hours' flying time. The passenger fare for each trip, it is predicted, will average about $200.

According to present plans, the transatlantic flight in summer will be charted on a non-stop course between New York and Paris by way of Newfoundland, while in the winter a southern route will be taken by way of the Azores.

As you look at the artist's fascinating picture you can imagine yourself boarding the big ship at a New York flying-field, some morning in the near future, soaring out over the sea, plunging through the sky at terrific speed for a day and a night above the vast expanse of ocean, and finally arriving in Paris bright and early on the following morning.

The Power *that Lies* in Your Eyes

Amazing Electrical Tests Explain the Mysteries of Man's Ability to Rule Wild Beasts

Why Man Is the Master

Doctor Russ' astonishing experiments indicate that actual radiation of electrical power from the human eye is the force that enables the animal trainer to rule and tame the wildest beasts

By Arthur Grahame

THE man cracks a whip and gazes commandingly at the tiger. The tiger glares its hatred for a moment, then looks away. Most dangerous of all the jungle clan, it could tear its tormentor to shreds with a few swift strokes of its mighty claw-armed paws. Instead, it cowers, trembling and, unwilling but submissive, goes through detested tricks.

This man who, armed with no weapon more deadly than a light whip, dares to match his will against the strength and ferocity of the most dangerous of animals, is no professional tamer of wild beasts. He is Charles W. Beall, senior vice president of an old and conservative Wall Street banking house.

Many of the big men of New York's financial district have their hobbies. Some sail racing-yachts on Long Island Sound. Some play polo at Meadowbrook. Others collect paintings. Mr. Beall trains wild animals. Instead of a polo stable he maintains a menagerie.

Standing with him in the building at Woodhaven, L. I., where he keeps his animals—at present the collection includes two tigers, three lions, three elephants, six leopards, one jaguar, and two monkeys—I asked him what gave him his unusual power over the lords of the jungle.

"Oh, just 'animal sense,' I guess," he replied. "A combination of a love of animals and an understanding of them."

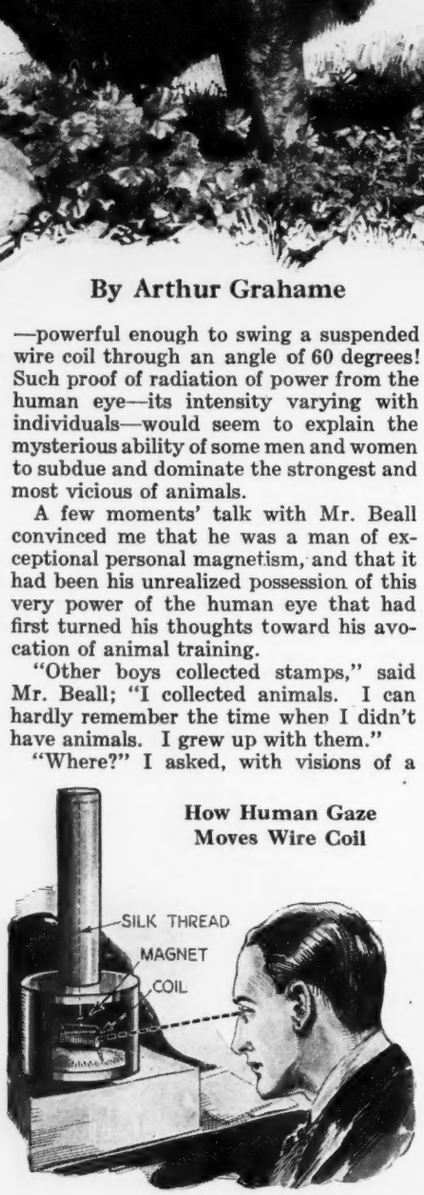
A GOOD answer from the practical animal-trainer's viewpoint, but science has one even more convincing. From a London laboratory comes news that Dr. Charles Russ, an English physician formerly connected with the electricity department of the Male Lock Hospital in London, has proved that the gaze of the human eye contains energy in some form—probably electro-magnetic energy—powerful enough to swing a suspended wire coil through an angle of 60 degrees! Such proof of radiation of power from the human eye—its intensity varying with individuals—would seem to explain the mysterious ability of some men and women to subdue and dominate the strongest and most vicious of animals.

A few moments' talk with Mr. Beall convinced me that he was a man of exceptional personal magnetism, and that it had been his unrealized possession of this very power of the human eye that had first turned his thoughts toward his avocation of animal training.

"Other boys collected stamps," said Mr. Beall; "I collected animals. I can hardly remember the time when I didn't have animals. I grew up with them."

"Where?" I asked, with visions of a boyhood spent at some African trading-post.

"Right here in New York City," replied Mr. Beall, smiling. "We lived in a big house, and I kept my menagerie in the cellar. I started with a bowl of goldfish. After that I had dogs and rabbits and squirrels. But such pets didn't satisfy me for long. I wanted something more unusual.



How Human Gaze Moves Wire Coil

Doctor Russ' experimental apparatus—a wire coil suspended by a thread inside a metal case and held steady by a magnet. The fixed gaze of human eyes, it was found, caused the coil to move from its former position

"FOR a long time I had followed the doings of the great animal trainers of that period with the same interest that boys of to-day follow the pitching of Walter Johnson and the home-running of Babe Ruth. I got to know some of these 'animal men'—fellows who made their living by capturing, training, and dealing in rare and dangerous beasts. Through one of these men I made my first real wild-animal acquisition—a pair of bear cubs.

"A little later I got a young leopard. A puma cub and an alligator followed. Before I was out of my teens I had added hyenas, panthers, and more leopards. By this time the cellar menagerie had become impossible. I had to move my animal collection to a farm in New Jersey, where I kept it for many years."

SO PERFECTLY trained are Beall's animals that he puts them to work for a part of each year. They have delighted thousands of visitors to New York's great playground, Coney Island, have performed in the New York Hippodrome, and have been rented to motion-picture production companies.

"And all those years, while you were working up from squirrels and bear cubs to elephants and tigers, you were learning how to control animals?"

"'Learning' is not exactly the right word," replied the banker-trainer. "'De-

veloping' would be more accurate. You see, it is largely a matter of instinct. The real secret of animal training is bluff. If you can keep up your bluff, you are safe. I never 'learned' to train animals; I developed a natural ability."

Just what is this mysterious natural ability? The experiments conducted by Doctor Russ during the last eight years supply an answer—the electric power of the human eye.

Doctor Russ claims to have proved that the ordinary man can move a suspended inanimate object by looking at it steadily. Developed to high intensity, it is probable that this electric eye power is what enables men like Mr. Beall to quell the ferocity of dangerous beasts.

THE evidence of modern science supports the belief that the human body is actually an electric power plant. All the muscles show electrical currents and variations of potential during action. There is an electrical change with each heartbeat. The retina of the eye has been shown to exhibit minute electrical activity during vision. Whatever the force coming from the eye might be, Doctor Russ decided, a part of it probably would radiate in the form of electricity.

Unlike Mr. Beall, Doctor Russ did not attempt to demonstrate this power by making a tiger leap through a hoop. Instead, he constructed the simple piece of apparatus shown in the illustration.

To demonstrate his theory, it was necessary that an object would move when the human gaze was directed on it, and to do this the object had to be placed under such conditions that nothing but eye power could account for the movement. Doctor Russ made a wire coil and suspended it by an unspun silk thread inside a metal case. One end of the thread was fastened to a cork at the top of the "chimney"; at the other end hung the coil. Just above the coil he fastened a small magnet, which, taking a north-south position, held the coil steady. The coil itself was so adjusted that it was in an east-west position. A small window in the metal case allowed the gaze to be directed at the coil, and made possible the observation of any movement. A scale was arranged below the coil for accurate measurement of the movement.

Electrical science has taught us that if a varying magnetic field meets a coil of wire, an electric current is generated within the coil and the coil becomes a magnet. If this magnetic coil is free to move, it will turn into the earth's magnetic meridian—into a north-south position. To do this, the coil in Doctor Russ' apparatus would have to overcome the force exerted by the magnet above it. This magnet, already in its proper north-south position, would object to being swung out of it. If, when the experimenter's gaze was directed on the coil, it moved against this force, it would prove the electric power of the human eye.

Doctor Russ took his station a short distance from the metal case and began to gaze steadily through the window at the coil. One second—no movement. Two, three, four seconds—still no movement. Five seconds—the coil started to swing! Within 10 seconds it had turned several degrees toward a north-south direction, forcing the little magnet above it out of its proper position.

Doctor Russ looked away. The coil swung back to its east-west line. Deprived of power from the eye, it could not keep the magnet from asserting its pull.

Continuing the trials with improved apparatus, Doctor Russ found that the first result had been no freak. For the wire coil he substituted a cylinder made

(Continued on page 121)

Tigers Obey His Will

Charles W. Beall, New York financier, whose hobby for years has been the training of wild animals, and whose remarkable power over tigers, lions, elephants, and jaguars is explained by electrical radiations of the eye

The Most Mysterious Man in the World

ONE of the most extraordinary series ever presented—the story of Houdini, the greatest magician of all time, the wonder worker who for 35 years has mystified the entire world—will begin in the next issue of POPULAR SCIENCE MONTHLY.

Houdini is more than a magician. He is a man of broad learning, a scientist, author, student, and philosopher. He numbers among his friends many of the greatest men of our time. He has been called the most mysterious man in the world.

Only one man knows Houdini's secrets. That is Houdini. And Houdini has written his own story so frankly, vividly, and intimately, that as you read you feel you are face to face with him hearing the fascinating narrative from his own lips.

YOU cannot afford to miss a single word of this enthralling series. The introductory article, a character sketch of Houdini, will appear in the October issue, published September 10. Order your copy now!

COLD WATER RETURNS FROM CITY
HOT WATER FOR HEATING HOUSES
CITY SUPPLIED WITH ELECTRIC LIGHT
RAILROAD AND TROLLEY LINES SUPPLIED WITH POWER
POWER HOUSE
RESERVOIR
STEAM POWER SUPPLIED TO INDUSTRIAL PLANTS
SUPERHEATED STEAM TO TURBINES
PUMPING PLANT
POWER SUPPLIED BY HYDROELECTRIC UNITS BELOW SURFACE
3 MILES
WATER BECOMES STEAM
STEAM CHAMBER (330°F.)

The proposed plan to utilize the earth's interior heat. Dotted lines and arrows show circulation of water that is turned into steam in a chamber three miles down

Can We *Pump Power from the* Earth?

By Ernest Welleck

WITH the rapid dwindling of the world's natural resources in stored fuel—coal, oil, and gas—engineers and scientists in recent months have been turning to the problem of tapping and harnessing the vast reservoir of heat in the interior of the earth.

The latest plan, and one of the most ingenious and elaborate, developed by Rudolf Lammel, a German engineer, is pictured here. It proposes drilling two shafts, one straight, the other with a number of rectangular bends, to a depth of three miles. This depth is about 2½ times that of the deepest shafts ever drilled. Both shafts lead to a large subterranean chamber cut out of solid rock.

If we estimate that with every 100 feet downward the temperature rises one degree Centigrade, the temperature of the walls of that chamber will be approximately 166° C. or 330° F. At a depth of three miles the air pressure is estimated at nearly two atmospheres, or about 30 pounds to the square inch. The boiling point of water under this pressure would be 248° F., more than 80 degrees lower than the temperature of the chamber.

FROM a reservoir on the surface, water is sent down through a pipe that follows the bends and turns of the stepped shaft to the chamber at the bottom. As the water rushes downward, it becomes gradually hotter, and at a depth of nearly two miles it turns to steam, which is forced into the chamber by pressure of the column of water above. In the high temperature of the chamber the steam is superheated and expanded. It seeks an outlet through the straight shaft.

Reaching the surface, the superheated steam is distributed first to the turbines of a light and power station, then to various industrial establishments and to residences and public buildings, where it is used for heating purposes.

HAVING given up its heat energy, the water is collected again in a reservoir, from which it is pumped back to the pipe, resuming once more its voyage to the natural heat plant and completing the cycle—water, steam, water.

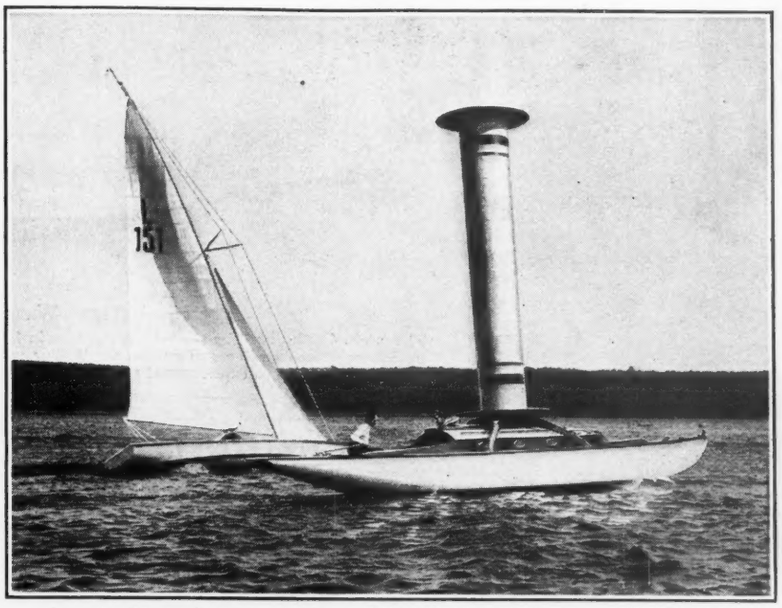
Even on its downward flow to the underground steam chamber, the water is put to work. At the lower end of each vertical section of the staggered conduit, a turbine driving an electric generator is inserted. The turbines in the upper two miles are water turbines; those in the remaining part of the shaft, steam turbines. The electric power thus generated is conducted to the surface to be used for driving pumps and other machinery required in running the heat and power plant.

The energy to be derived from a plant of this description, of course, depends on the volume of water available. Assuming that a constant flow of 13 cubic yards a second is obtainable, as it is in many existing hydraulic power plants, the potential energy made available by heating that volume of water to 330° F. would be equal to nearly 3,000,000 kilowatts a day, representing an economic value equal to 70,000 tons of good coal a day.

America's First Rotor Boat

Naval Officers Embody New Ideas in Odd Craft

THE interest with which the strange rotor ship designed by Anton Flettner was greeted a few months ago, when it sailed out into the Baltic Sea, little surpassed that of the spectators who recently watched the trial voyage of the first rotor boat in America, on the Charles River at Cambridge, Mass. This American boat, constructed by two young naval officers, was the first actual demonstration in this country of how a revolving metal tower can replace canvas sails.



A spectacular race between new Flettner single-tower rotor yacht and a sailboat, staged recently near Berlin. The sailboat won. Flettner's first rotor ship had two towers

Lieutenants Joseph M. K. Kiernan and W. W. Hastings, students in naval architecture at the Massachusetts Institute of Technology, were greatly interested in reports of the rotor ship. They decided to build one for themselves. They acquired an abandoned navy cutter about 30 feet long and eight feet wide, and with discarded materials from other boats fixed up the rotor apparatus.

In designing the tower they used data gathered in exhaustive experiments in aviation at Langley Field, Va., where for some time the United States Army has been studying the application of the Magnus theory of air pressures to aircraft. The American boat employs the Magnus effect, just as the German boat does.

The Magnus principle, as applied to a rotor boat, may be expressed as follows:

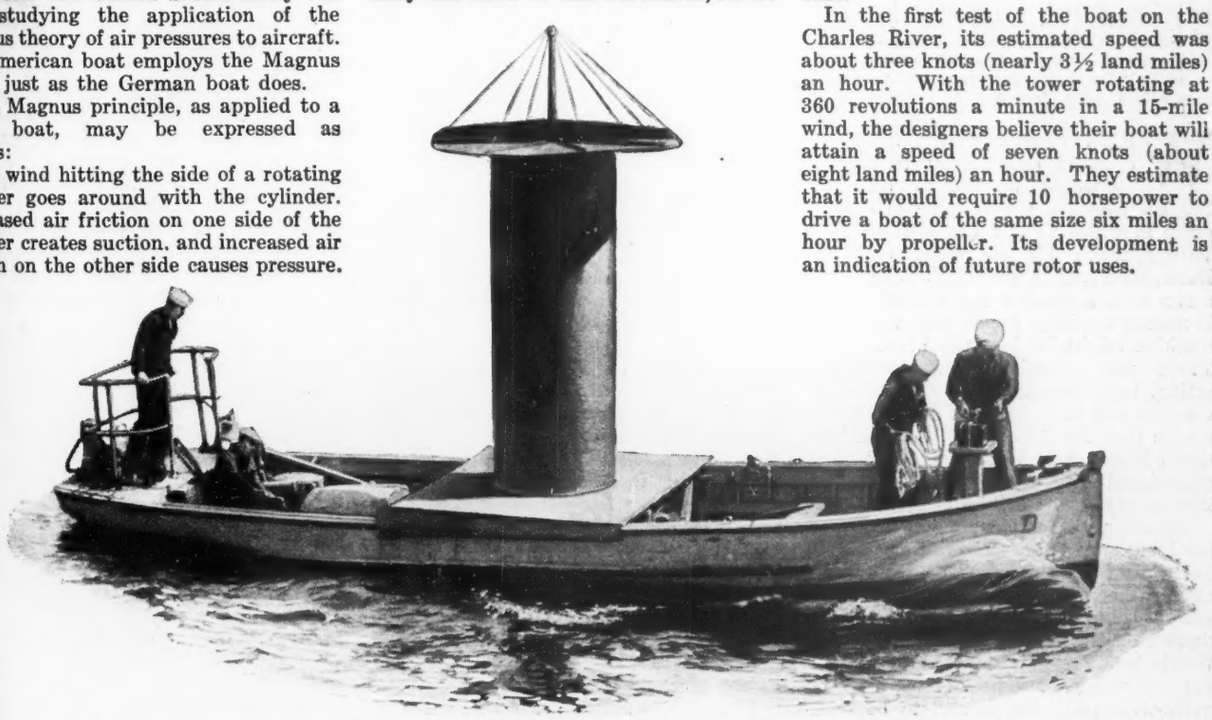
The wind hitting the side of a rotating cylinder goes around with the cylinder. Decreased air friction on one side of the cylinder creates suction, and increased air friction on the other side causes pressure. These two forces, together, move the boat.

The American boat differs in several respects, however, from Flettner's craft. While the German inventor used two cylinders on his 600-ton boat, the Americans decided to use only one on their cutter. They believed that when two cylinders were used, one interfered with the other's action. Flettner also apparently has come to this conclusion, for he is experimenting now with a single-tower system of propulsion as indicated by one of his latest designs—a rotor yacht that recently appeared in Germany in competition with sailing-yachts.

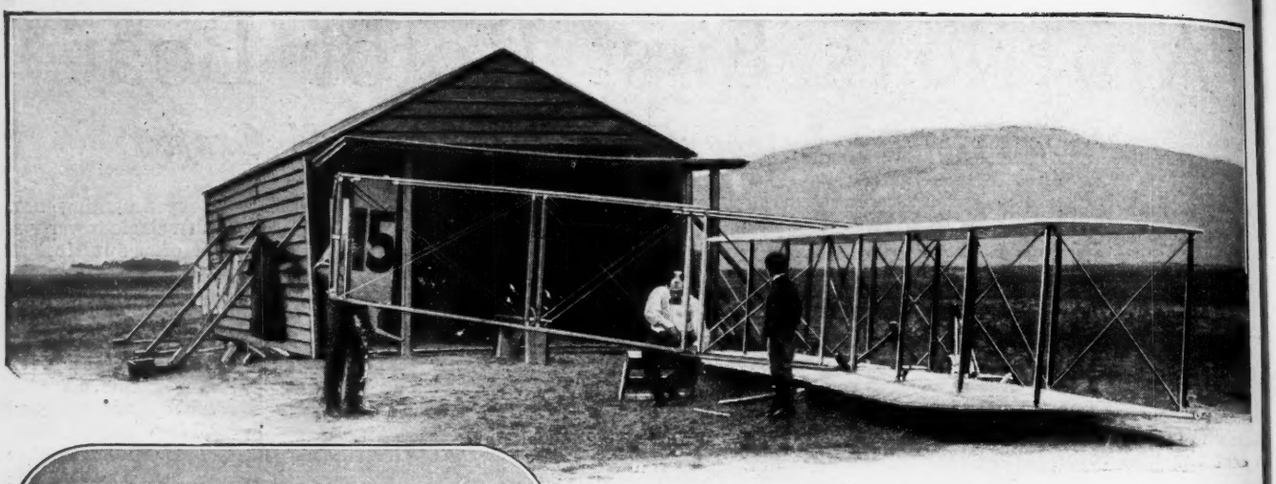
The cylinder designed by Lieutenants Hastings and Kiernan for the American craft is 3½ feet in diameter and 9½ feet high. This is smaller in proportion than the tower used on the original Flettner ship, and it revolves at greater speed. On the Flettner ship, at the top of each of the cylinders, was a rim projecting about 14 inches. The purpose of this was to maintain the suction and pressure zones extending up and down the opposite sides of the cylinder, and to prevent air from entering these zones from above and disturbing them. These rims revolved with the cylinders.

The disk used on the top of the American's rotor tower is stationary. The rotor tower is mounted in the middle of the boat on a ball-bearing base and is supported by an interior column. It is driven by a five-horsepower motor located at its base.

In the first test of the boat on the Charles River, its estimated speed was about three knots (nearly 3½ land miles) an hour. With the tower rotating at 360 revolutions a minute in a 15-mile wind, the designers believe their boat will attain a speed of seven knots (about eight land miles) an hour. They estimate that it would require 10 horsepower to drive a boat of the same size six miles an hour by propeller. Its development is an indication of future rotor uses.



America's first rotor boat on its trial trip. It was designed and built from an old 30-foot naval cutter by two young naval officers, Lieuts. Joseph M. K. Kiernan and W. W. Hastings. Its estimated speed was about 3½ miles an hour

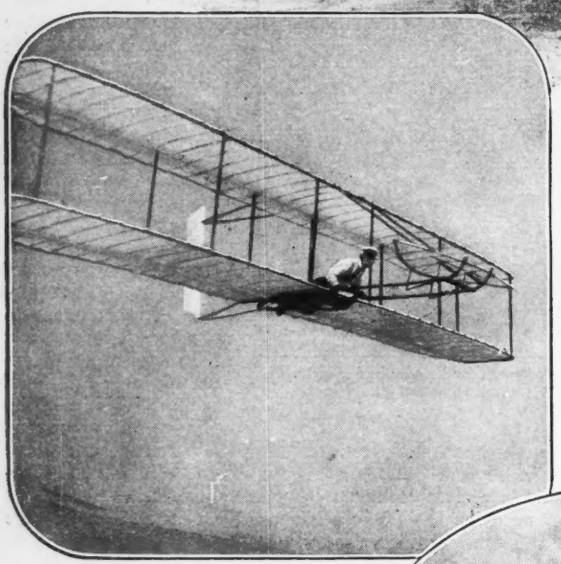


Where the Airplane Was Born

The original camp built by the Wright brothers in 1900 at Kitty Hawk, N. C., birthplace of the airplane. Orville and Wilbur are seen hard at work on one of their numerous experimental glider models, with a small boy as spectator

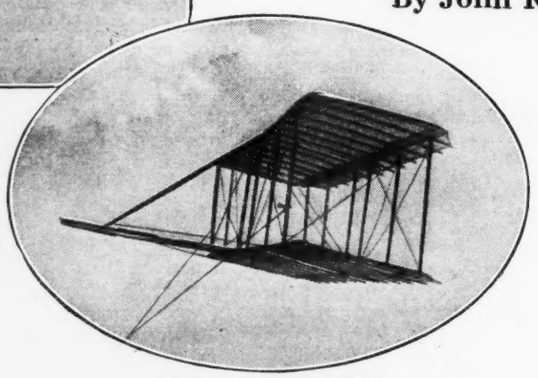
How a Twisted Paper Box Gave Us Aviation

By John R. McMahon



The Air Conquered

Wilbur Wright flying the successful glider of 1902. The operator, lying on his stomach and clutching the controls, had to shift his weight quickly to balance the craft and avoid a crash. The author of this article was one of the first to report the epoch-making experiments of the Wright brothers. He writes from personal experience and observation



The First Wright Glider

The first actual heavier-than-air machine built by the Wright brothers, embodying their idea of warping, was this glider flown in 1900 at Kitty Hawk. Its wing span was 18 feet, with a chord of five feet. This picture shows one of the experimental flights, with the glider used as a kite, operated by cords from the ground

WHEN Orville Wright announced last spring that he would present to an English museum the pioneer airplane in which he and his brother Wilbur made historic flight on December 17, 1903, there was quite a stir in this country and abroad. President Coolidge hoped that the machine might be kept at home. There was promise of Congressional action, both to retain patent models in America and to investigate Mr. Wright's charge that the Langley relic in the National Museum at Washington had been refurbished improperly, manipulated and labeled to support a priority claim.

We can wait for Congress to clear up the Langley matter, which, after all, is a question of "might have" or "afterward also" rather than "did fly first." Meanwhile it is interesting to have a bit of light thrown on the yet obscure details of the Wright brothers' independent and marvelous achievement. Their story, despite world-wide publicity, is still to be told. One reason for this is the death of Wilbur, the elder brother, in 1912.

The young bicycle men of Dayton, Ohio, had been discussing the problem of flight for about three years when the first real idea came to them in June, 1899. They had spent Sundays lying on their backs beside the Miami River, hoping to learn something from the stately maneuvers of hawks and buzzards in the blue overhead. Then came that first real idea, which was Orville's—to obtain lateral balance by hinged wings.

"The hinge is a good idea, but not practical," agreed the brothers after debate. This was their judgment as expert mechanics.

The bicycle shop that the young men conducted was kept open late evenings to cater to the trade of factory employees. Wilbur was on duty one night in July, some weeks after the hinge concept had been argued and seemingly discarded.

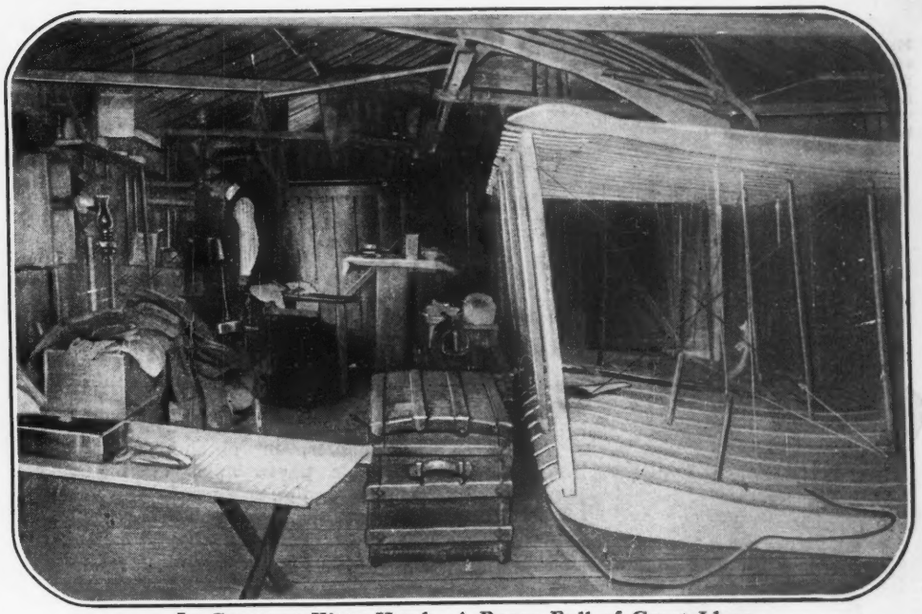
A customer came in. If he had asked for tire tape, a wrench or a pump, the course of history might have been changed. But this customer asked for an inner tube for his bicycle tire. That tube was packed in a rectangular pasteboard box. Wilbur held the empty box by its ends while the customer examined the contents. Wilbur's hands were inclined to be nervously active. He looked down and suddenly realized what he was doing with an empty box—twisting it—warping it. What was this? Can't hinge wings? Never. But you can warp them! Eureka!

Wilbur closed the shop in a hurry and rushed home to tell Orville.

Usually each brother, in the interest of truth, savagely assailed the other's idea. This time Orville heard the box story, made no argument, and just accepted Wilbur's warping amendment to the hinge principle. Then and there one-half of the problem of lateral balance of the airplane was solved for all time. It was simply a great inspiration, like Newton's falling apple.

THE Wrights had a cozy home on Hawthorn Street and there was much affection among its four dwellers—brothers, sister and father. The mother had died some years before. Katharine had taken her place as far as possible.

Fascinating Glimpses of the Airplane's Birth Revealed for the First Time by One of the Early Associates of the Wright Brothers



In Camp at Kitty Hawk—A Room Full of Great Ideas

Interior of the shed camp de luxe at Kitty Hawk in 1902, showing Wilbur Wright at work on the glider of the previous year. In this camp Orville officiated as chef, running his kitchen mathematically

Home love and unity were also factors in the birth of aviation. The "boys" always found their recreation and deepest enjoyment in the home circle. They tinkered around and improved the frame dwelling with their own hands, adding a porch among other things.

Within a month after the warping scheme came to them, the Wrights tried it out on a box kite that they flew from Seminary Hill in Dayton. A large audience of small boys begged to assist. The kite, a five-foot biplane, acted badly from the small boys' viewpoint—it scooted here and darted there like mad, but satisfied its makers, since it responded to the control cords that twisted its frame.

NEXT in order was to test the idea in a man-carrying glider, which the brothers started to build the following winter.

Wilbur pioneered the first trip to Kitty Hawk, N. C., in the fall of 1900 and on the way was almost wrecked in a fishing boat. Mrs. Tate, wife of the local postmaster, let Wilbur use her sewing-machine to stitch together the wing coverings of the glider. In return for this courtesy it was only fair that next year the postmaster's little girls should be wearing very fancy dresses of cream-hued sateen, made out of glider wings. And if those dresses still remain, they are certainly heirlooms!

The brothers had agreed to take turns in going up. Wilbur had the first air ride, Orville holding a rope tied to the machine. How that winged broncho bucked! It danced, it cavorted. Alarmed by its gyrations at the dizzy height of perhaps 10 feet above ground, the co-sire of aviation yelled in his sharp staccato:

"Lemme down! Lemme down!"

Afterward, when teased by his family for "Lemme down!" Wilbur always had an alibi, that he had promised his father to take care of himself; and everybody, including himself, would laugh.

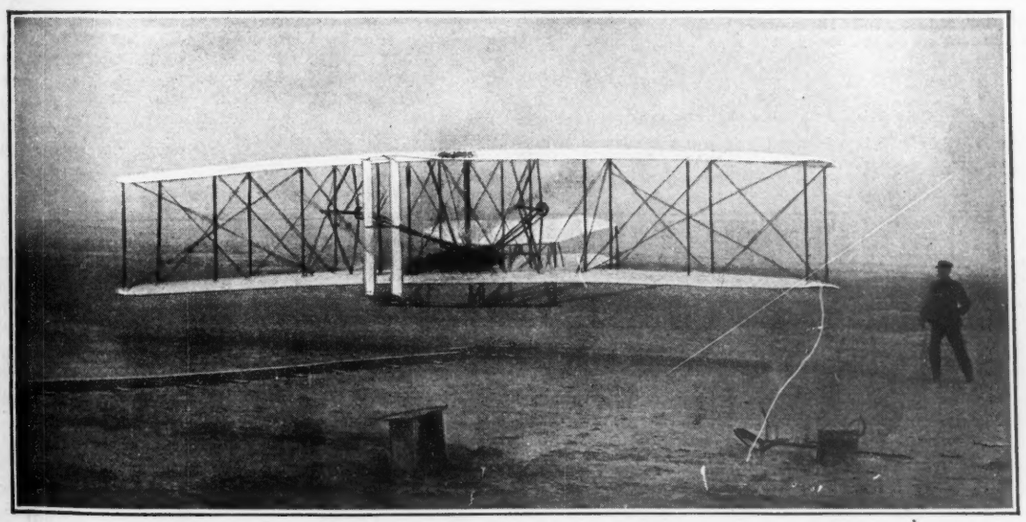
While the warping principle passed the test in pioneer voyages, the brothers now saw flaws in the classic air tables on which curves of planes and other things depend. Home again, they tried to solve the mysteries of air pressure with a whirling wind-vane attached to the front of a bicycle. A young man pedaling around Dayton with such a contraption naturally gave pleasure to spectators. One of the latter must have been clairvoyant of the secret purpose, for he was heard to state:

"That fellow can run his gizzard out, but he'll never make that thing go up!"

At a later period, amid a skepticism almost universal, the brothers found one true believer, Charles Webbert, landlord of their bicycle-shop quarters. It is touching to think of this first convert—a landlord to boot. How it must have encouraged the young experimenters! They did thank him for his faith, regardless of its basis. It seems Mr. Webbert was a spiritualist and thought the brothers flew by aid of the spirits.

A larger glider was planned for the next year and again Wilbur stitched up the wing covers, but this time on the family sewing-machine and on the side porch of the Wright's homestead. Any passer-by on Hawthorn Street could see that lean, sharp-eyed young man laying out muslin on the grass, snipping it in bias

(*Continued on page 128*)



An Epoch-Making Moment—Start of the First Power Flight

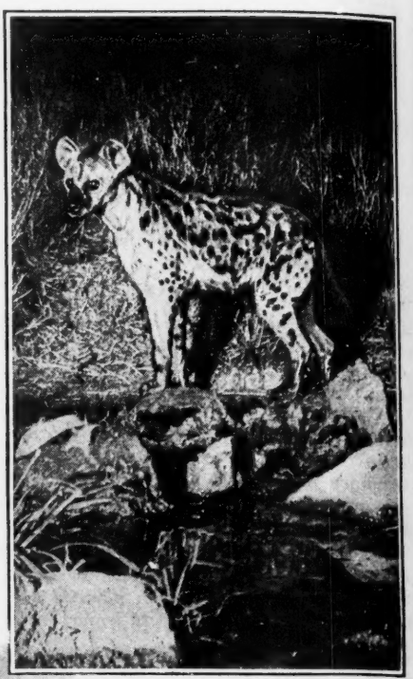
This is one of the most prized photographs in the world. It was snapped at Kitty Hawk December 17, 1903, just as the Wrights' first power plane took the air at the end of its monorail runway. Orville was the pilot. As the machine started down the track and into the wind, Wilbur ran at the side holding the wing to balance the machine. He was able to stay with it until it lifted after a 40-foot run. A member of the Kill Devil Hill life-saving crew snapped the camera an instant after the machine had left the track and had risen about two feet. Wilbur is seen still running at the side, watching the historic first flight

Hunting Wild Beasts by Flashlight

Thrilling Jungle Photos at Close Range

Here Major Dugmore is seen setting the flashlight device with which he made his remarkable close-up photographs of jungle beasts in native haunts

CAMERAS instead of rifles; flashlights in place of gunpowder—these were the hunting weapons used in the wilds of African jungles by Major Radclyff Dugmore, daring naturalist, artist, and explorer, in obtaining the remarkable photographs of big game pictured on this page. Only twice did he use a rifle, and that was when angry lions, whose pictures he was seeking, charged him. Major Dugmore's method was to find out the animals' own kill and lie in wait for the return of the killer, at a distance of about 10 or 12 yards.

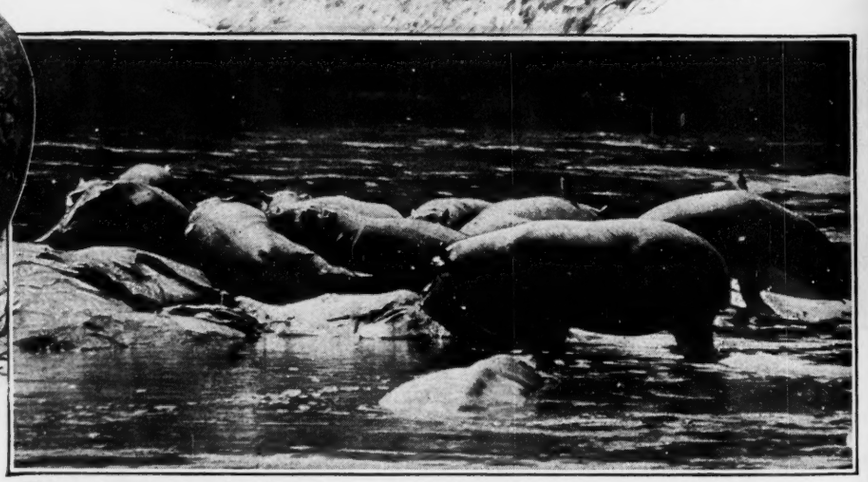


Below is an extraordinary picture of a wounded lion, one of two shot by Major Dugmore after they had charged him. This was taken at a distance of only eight yards from the roaring beast

This lioness, returning to her own kill, suddenly spied the cameraman 10 yards away, who at that instant set off the flashlight

Many nights were spent by Major Dugmore in the black depths of the jungle to obtain this remarkable flashlight picture of a spotted hyena

A huge rhinoceros charging, photographed at range of 16 yards. When aroused, this is one of the most dangerous animals



Hippopotamuses, sunning themselves on the bank of a river, all unaware of the photographer

Still to Be Won!

444 Cash Prizes

in Our Remarkable

$10,000 Contest

"I'VE been so busy making mistakes in a new home of my own that I haven't had time until now to worry about the mistakes of John and Mary Newlywed," writes a Detroit suburbanite. "Am I too late to try for a prize in your $10,000 picture contest? And if not, how can I get in?"

No doubt others have let the weeks slip by since our great cash prize contest was announced in the June issue and are asking a similar question.

There is still plenty of time for everybody. Although the fourth and final set of "What's Wrong" pictures appears in this issue, on the next two pages, there still remain exactly 444 out of the original 580 cash prizes to be awarded. That means that you have an equal chance with everybody else to win one or more of 444 prizes totaling $8000.

The first thing to do is to turn this page and look at the eight contest pictures for September. The contest has to do with the enthusiastic but inexperienced efforts of John and Mary Newlywed to do odd jobs about the home they have just moved into. Each picture shows John or Mary doing one of these jobs in the wrong way. And in addition, our artist has deliberately drawn one thing in each picture incorrectly. What you are to do is to find what John or Mary is doing wrong, why it is wrong, and what mistake the artist has made.

You can practise on the picture at the bottom of this page, which was printed as an example, to show you how to go about the contest. First, what is John doing wrong? Obviously, he is varnishing a table in the smoke from the back yard incinerator. If you don't know, you can easily find out why this is wrong and how it should be done. Next is the observation test. What mistake has the artist made? What about the shadows? Is it right that the shadow cast by the varnish can should fall in a direction opposite to that of all other shadows?

THE eight pictures published this month form a complete contest in themselves. Similar sets of eight pictures appeared in the June, July, and August issues, making four complete monthly contests in all. And, in addition, there is a Grand Prize Contest in which $6000 in prizes will be awarded for the best answers submitted for all 32 pictures in the four monthly contests. The last two of the monthly contests, as well as the Grand Prize Contest are still open for your entry.

You have until August 30 to submit answers to the pictures in the July contest, and you have until September 30 to submit answers in this month's contest and in the Grand Prize Contest. If you have mislaid your copies of the June, July, and August numbers, and if your newsdealer cannot supply you, copies of these issues may be examined free at the offices of this magazine or in the public libraries. If you wish, you may obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.

It costs you nothing to enter. All you need is to be observant and alert. You can submit as many sets of answers to the pictures as you wish, and if you run into difficulties you can call on members of your family, your friends, or neighbors for assistance. But before you start to write your answers, be sure to read the rules of the contest. These you will find on page 122 of this issue.

THE names of the prize-winners in this month's contest will be announced by the judges in the February issue of POPULAR SCIENCE MONTHLY. Winners of the Grand Prizes will be announced as soon as possible after the close of the contest. Three judges, members of the staff of the Popular Science Institute of Standards, will decide on all awards.

Remember the final date—September 30. Better sit down now and write out your answers while there is still plenty of time. You are sure to find the contest fascinating and profitable.

Practise on This Picture

In this sample "What's Wrong" picture, John is seen varnishing a table in the smoke of the back-yard incinerator. Why is this wrong? You will see, too, that the artist has made the shadow from the varnish can fall in the wrong direction

Your Last Chance to Win One or More of These Big Prizes

IN THE June issue we offered $10,000 in 580 cash prizes for the best answers submitted in this contest. Of these prizes 444 still remain to be awarded. The prizes offered in each monthly contest are:

First Prize	$500
Second Prize	$100
Third Prize	$50
5 Prizes, $10 each	$50
60 Prizes, $5 each	$300
Total, four months	$4000

In addition, cash prizes in the Grand Contest will be paid as follows:

First Grand Prize	$2500
Second Grand Prize	$1000
Third Grand Prize	$500
5 Grand Prizes, $50 each	$250
50 Grand Prizes, $10 each	$500
250 Grand Prizes, $5 each	$1250
Total Grand Prizes	$6000

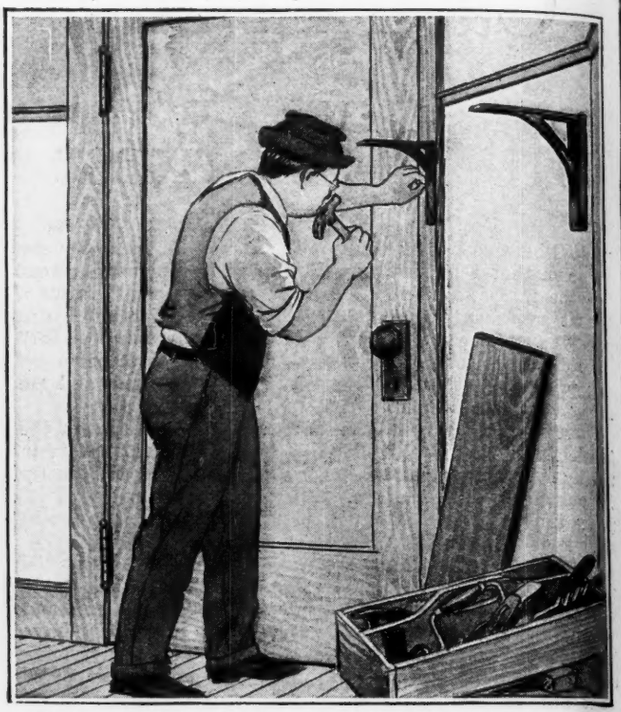
COMPLETE RULES FOR THIS SENSATIONAL "WHAT'S WRONG" CONTEST ON PAGE 122

A $10,000 Test of Observation and Alertness

What's Wrong in

In Each John Is Doing Something Made One Error

1. John isn't satisfied until the garage door is padlocked against auto thieves. He purchases a hasp and staple, and is seen here as he energetically tightens the last of the screws



2. Mary's desire for an extra shelf in the bedroom gives John another chance to use his new set of tools. Here he is starting the last screw in the angle bracket shelf support

3. This is John's first experience in removing a tire from its rim. But with the aid of a couple of tire irons and a hammer he sets boldly and confidently to work on the job

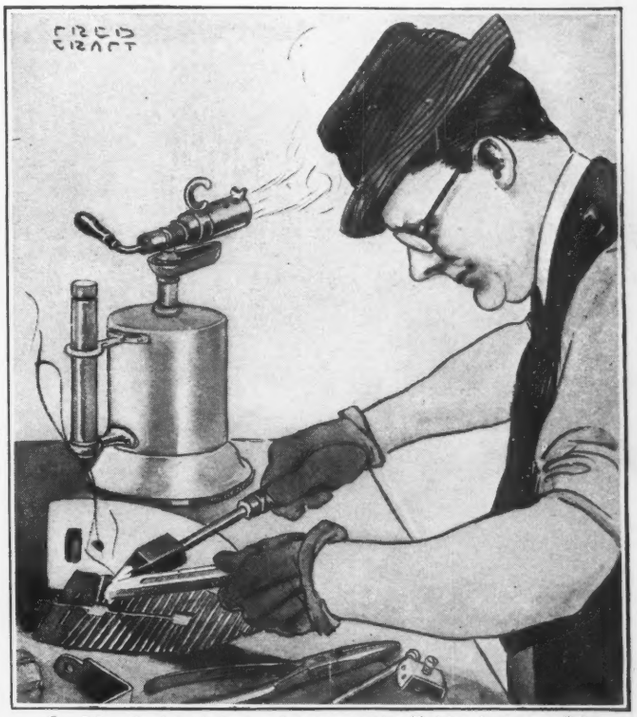
4. John loses no time in adopting Mary's suggestion for a catch-lock on the door. It looks so easy that he anticipates nothing but a perfect job when he has finished it

These Pictures?

Wrong, and in Each the Artist Has in the Drawing

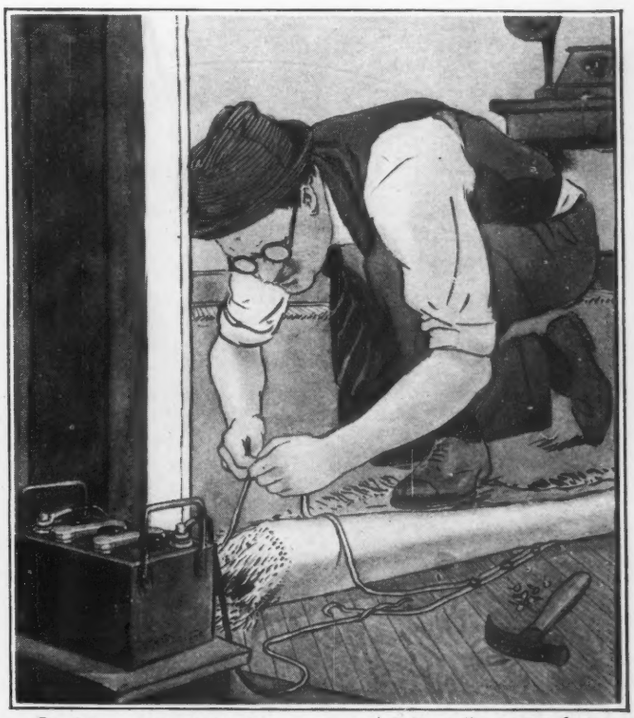
Read the Rules of This Amazing Contest–Page 122

5. The woodwork in the breakfast nook is too dark and gloomy, Mary thinks; so John gets a can of white enamel and starts enthusiastically painting the trim around the window



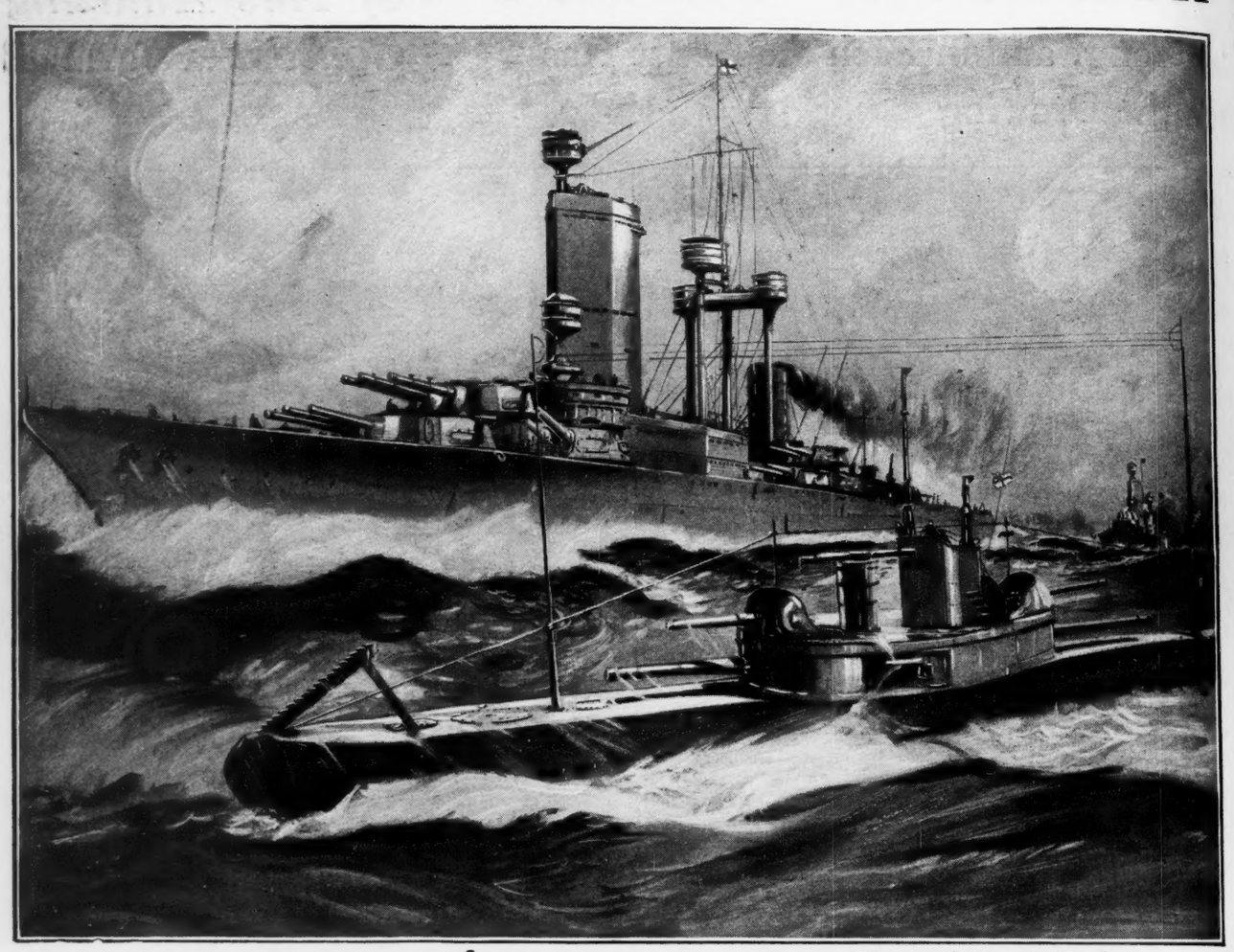
6. Mary's electric iron refuses to work. Taking it apart, John discovers that a wire is broken in the heating unit. Eagerly, though with little experience, he proceeds to solder the break

7. Though he knows little about electrical appliances, John determines to give the noisy electric fan a thorough oiling. Here he is undertaking the job with enthusiasm



8. Mary protests at the appearance of the radio storage battery in the living-room. Eager to please her, John conceals the battery in the closet and runs the wires under the rug

Marvels of Marine Invention

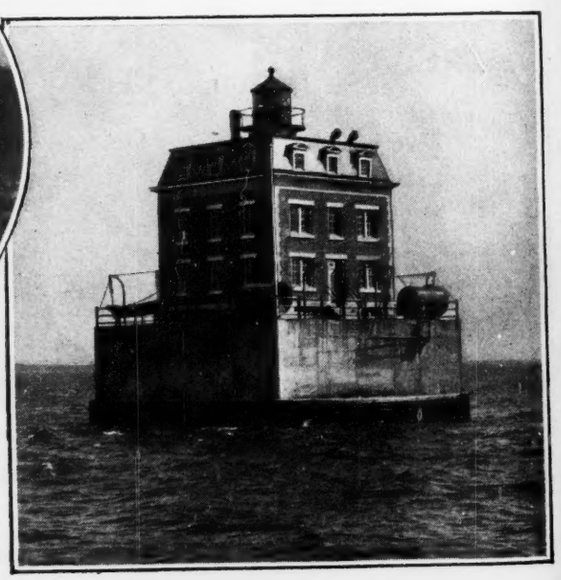


Latest Rivals of Naval Warfare

Despite repeated assertions by experts that the warship is doomed, warships still are being built on a larger scale than ever before. The latest type battleship, represented by the 30,000-ton *Nelson* and *Rodney* laid down in England, is 700 feet long, capable of steaming 24 knots, and carrying six 16-inch guns. It is pictured here, together with a German naval architect's recent conception of the modern battleship's greatest rival, the giant submarine cruiser

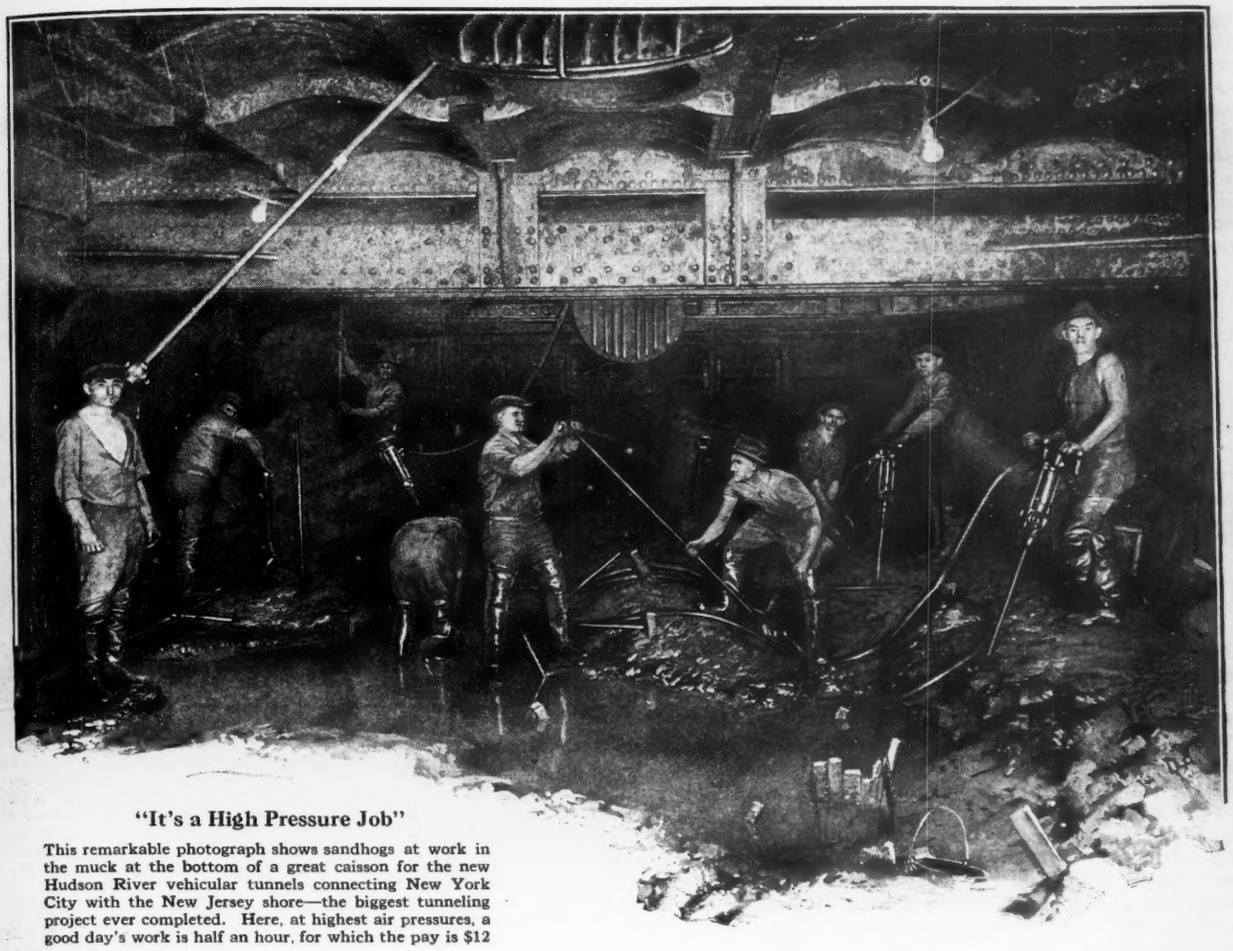
Two Boats in One

A racing sailboat with a double hull—two pontoons connected by cross braces—is the novel idea of an Italian inventor, Luigi Penco



A Floating Lighthouse

The floating brick residence shown at the right is one of the world's oddest lighthouses. It is located off the coast of New London, Conn.



"It's a High Pressure Job"

This remarkable photograph shows sandhogs at work in the muck at the bottom of a great caisson for the new Hudson River vehicular tunnels connecting New York City with the New Jersey shore—the biggest tunneling project ever completed. Here, at highest air pressures, a good day's work is half an hour, for which the pay is $12

Where Half an Hour *Is a* Day's Work

Thrilling Experiences of a Veteran Sandhog, Who for 30 Years Worked Deep in Caissons and Tunnels

By Frank Parker Stockbridge

"SURE I like it. Why shouldn't I? Short hours, big pay, an' easy work into the bargain. Who wouldn't like a job like that, I'm askin' ye?"

Paddy Ryan, veteran "sandhog," spat emphatically into the gutter as he delivered that eulogy of his day's work. Paddy was just through with his job in the Hudson River vehicular tunnels, the biggest tunneling project ever completed, with the twin 30-foot tubes making an under-water roadway for automobile traffic between New York City and the New Jersey shore. And being the biggest of all under-water tunnels, it was the biggest sandhog job on record. Twelve hundred of these men, doing their day's work below the river-bed, had burrowed those mile-long holes through the mud, and some of them—Paddy Ryan for one—were proud of their achievement.

From where we stood, in West Street on the New York water-front, we could see the towering steel skeleton of the city's newest skyscraper. The clatter of the pneumatic riveting hammers resounded like the tattoo of a flock of giant woodpeckers. Paddy took a long puff at his pipe, removed it from his mouth and waved it in the direction of the sound.

"Now, them boys," he said, with an inimitable burr that defies type, "them boys takes their lives in their hands every time they goes to the top. When they fall they've got a long ways to drop. Now, us lads that works in the tunnels an' caissons don't take no chances like that. There ain't no place for us to drop. We're already at the bottom, an' then some."

Paddy laughed at his own joke. There was no doubt of his belief that the sandhog's job of sinking caissons and digging tunnels under compressed air was far superior to the risky business of climbing aloft among the beams and girders.

"Yes, sir," he went on, "there ain't no place for a sandhog to fall to, without he lets go of the ladder goin' down into a caisson, though I mind me of Dan Murphy that was killed by a wooden plug, no bigger than would stop a jug, fallin' 80 feet an' hittin' him on the head when he was at the bottom o' one o' the caissons o' the Manhattan Bridge, crossin' the East River, at New York. Them was monsters, them caissons. Ever been down in one, mister?"

I pleaded ignorance. Paddy beamed with a superior air.

"IT'S like a big box with a top an' no bottom, a caisson is," he said. "At the top is the air lock, an' at the bottom is the muck—earth or sand or gravel or hardpan or rock—whatever stands between the surface of the earth an' bedrock. Y' see, the purpose of the caisson is to clear everything away, down to the backbone o' the world, so they can have somethin' solid to rest their steel an' concrete on. What good would all that be if it wasn't on rock at the bottom?"

He waved his pipe again at the skyscraper. "Them boys wouldn't have no jobs at all if it wasn't that us sandhogs did our job first," he went on. "Now it stands to reason that when you get down a certain ways underground you strike water, an' that 's why you've got to use caissons, unless the bedrock comes above the water line. Ninety-four feet, them Manhattan Bridge caissons went down,

How 30-Foot Tubes a Mile Long

to set the foundations for the cable towers, an' 60 feet o' that was below water line. Sixty foot head o' water trying to get in through the open bottom of the big box, an' nothin' to keep it out but the air they was pumpin' in from above. Do you know how to figure out what the pressure is at 60 foot?"

Again I had to plead ignorance. "I'd have to look in a book for that," I said, and Paddy smiled his superior smile.

"AN ENGINEER once showed me how," he said. "It's 4 1/3 pounds for every 10 foot o' water. What does that come to for 60 foot?"

"About 26 pounds to the square inch," I replied. after a moment's mental calculation.

"That's about it," said Paddy approvingly. "That's not much—only a six-hour pressure. I've worked in lots higher pressures than that, an' I'd rather do it. The hours are shorter an' the pay's higher."

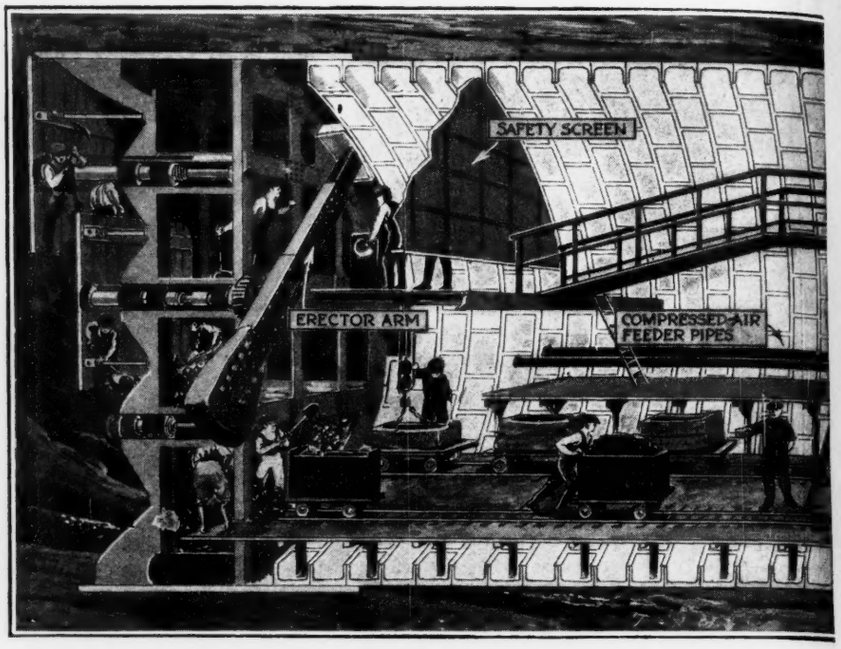
I didn't understand, and Paddy saw that I didn't.

"They figure out a sandhog's pay and his working hours accordin' to the pressure he's got to work under," he explained. "Up to 18 pounds it's an eight-hour day an' eight dollars a day, in tunnel work. That's two four-hour shifts, with two hours' rest between 'em. All sandhog jobs are two shifts, for nobody can stand the pressure for a full workin' day. An' the higher the pressure, the higher the pay an' the shorter the day. In caisson work the pay's a bit higher, and there's seven kind o' days, one for pressures up to 18 pounds an' eight hours' work; the next is six hours, from 18 to 26 pounds, an' so on up to pressures above 48 pounds. That's *some* pressure! An' how long do you think a day's work is under that much air? Half an hour! Two 15-minute shifts, that's all. But the pay goes up 50 cents a day for every step up in pressure, so a miner—that's me—gets 3½ dollars on top of his eight-fifty, for half an hour's work. Twelve dollars for 30 minutes!

"IT AIN'T often we have to work under top pressures, though. Deepest job I ever worked on was the Pennsylvania tunnels, from the Jersey shore to the Pennsylvania Railroad terminal in New York. On that job we got down to 90 feet. That was only about 40 pounds pressure."

Paddy paused and relighted his pipe nonchalantly. Evidently working "under air" agreed with him. Unlike the structural-steel workers, few of the sandhogs are of the slender, wiry type. They run rather to fat than otherwise, and Paddy Ryan is no exception to the rule.

"Sure we get fat, an' why wouldn't we?" he responded to my comment. "Man, what an appetite it does give you, workin' under air! A company doctor explained it to me once. It seems it's because we inhale more oxygen every time we breathe the compressed air than we do on the surface, an' it's the oxygen that burns out the waste in our blood an' tissues. There must be somethin' in that, for any kind of a fire burns faster under the air. My pipe, now—three puffs an' it's burned out, under 30 pounds pressure. They don't stand for smokin' on the job, though. A sandhog that does is blacklisted. In the old days, before there was electric lights everywhere to work with, an' we had to use candles, a candle would burn out in no time. Sometimes after a candle was blown out it would light up again from the spark on the wick, just because of the oxygen.



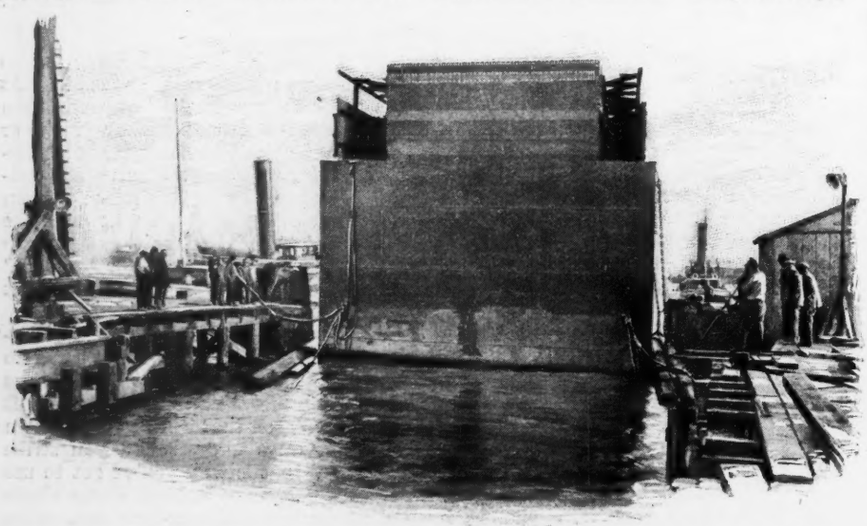
Pictorial diagram showing how boring operations were carried on in Hudson vehicular tunnels. In the compressed-air chamber behind the working face, at extreme left, is an arm that lifts cast-iron segments in place for the tube lining. A safety screen across the upper part of the tube provides means of escape for the sandhogs in case of a blowout

"SAY, that reminds me of a funny thing," Paddy went on, after a few reminiscent puffs at his pipe. "There was a sandhog named Louis Cassari, an Austrian. He was an old-timer, and he held the record for the longest time under air—16 hours, under 30 pounds. Well, Louis blew out his candle in the caisson one day an' put it in his pocket, an' you can call me a Dutchman if it didn't light up again in his pocket. First Louis knew about it was when he felt his leg burnin', and there was his pants half burned off!

"Yes, sir; it's the oxygen in the compressed air that burns up the food we eat, so we have to be sure to eat enough. An' I suppose it's the same thing that makes it easy to work under air. Kind o' like a stimulant; everything's easy to do. Fellows that are too lazy to shake down the kitchen stove'll do a big day's work in a caisson or a tunnel an' think nothin' of it. You don't get tired at all."

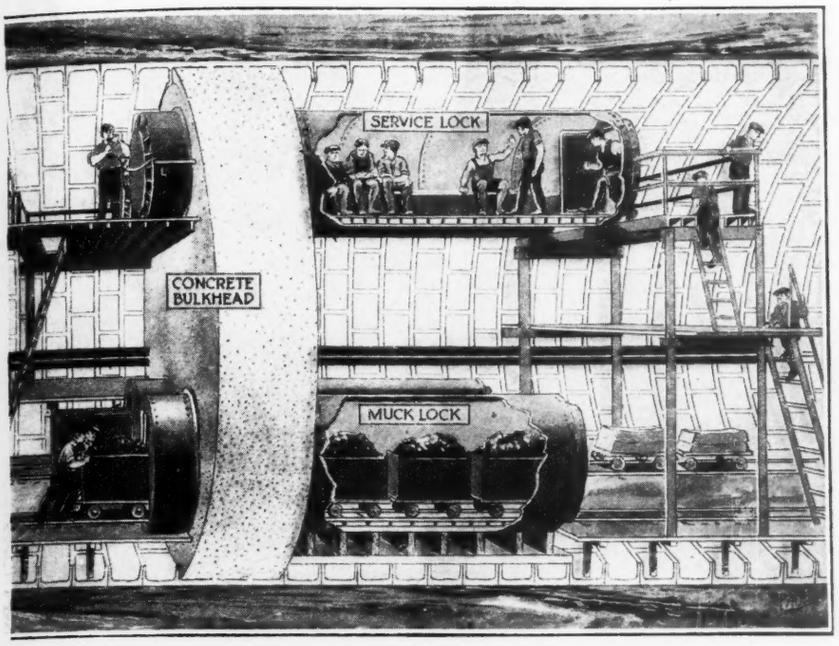
"Pretty dangerous work, though, isn't it?" I ventured. "Doesn't it knock a man's system to pieces, if he keeps it up?"

"You're thinkin' about the 'bends,' that there used to be so much about in the papers," replied Paddy. "Well, it's the same with this sort o' work as with any other—a man's got to take care of himself. Everybody has to. You have to, don't you? Well, then, a sandhog that doesn't take care of himself off the job'll die sooner than the ones that does, but



One of the big steel caissons for the vehicular tunnels, towed into position for sinking

Were Driven under the Hudson



A concrete bulkhead separates the compressed-air working chamber from the outside. Through this pass the compressed-air feeder lines, as well as the air lock in which the sandhogs are "compressed" when they go into the workings and "decompressed" when they come out. There is also a muck lock for passing excavated material

there's nothin' in workin' under air to hurt a fellow. Look at me, now. I've been workin', caisson an' tunnel jobs, on the other side an' over here, for 30 years, an' I'm good for 20 years yet.

"TAKE your time in the air lock, especially comin' out, an' don't let the lock-tender change the pressure too fast, an' you're all right. There's an air lock at the top of the caisson or the shore end of the tunnel. When you go in, they close the door behind you, an' turn on the air till it gets up to the pressure inside the workin'. Comin' out, it works the other way. Goin' in you can take it faster than comin' out; that's where the boys used to get into trouble and get the 'bends,' comin' out of the air too fast. Thirty seconds in the air lock for every pound of pressure is the rule, but sometimes a sandhog that's in too much of a hurry'll turn the valve when the lock-tender isn't lookin'.

"That's not much this side o' murder, for while it might not hurt him, it might kill some o' the rest o' the gang in the lock, or cripple 'em for life. That's when you get the 'bends'; by comin' out too fast. It's like the jumpin' toothache an' the worst kind o' rheumatism combined, an' if it hits you in the head you go daffy. If it gets you in the belly you have the worst colic you ever heard of. There's only one way to cure it, an' that's to go under the air again, and ease off the pressure gradual. It's little bubbles of air that gets into the blood, under the pressure. They work out through the lungs if you give 'em time."

Paddy's pipe called for attention again. There was the far-away look in his eyes as he relighted it which told me another reminiscence was coming.

"There was a comical thing happened in the Blackwall tunnel, under the Thames, in London, where I done my first work under air," he said. "I was workin' for Jimmy Sullivan, the best foreman I ever worked under. He was an old-time sandhog, only they call 'em all miners over there. He'd worked in the caissons of the Forth bridge an' come over here, once, in 1890, when an English company was tryin' to run a tunnel under the Hudson, the one McAdoo took hold of afterwards an' finished—what they call the Hudson Tunnel now.

"Well, we had the tunnel through, though the air was still on, while we was puttin' in the lining, when two members of the London County Council thought it would be a nice thing to make a tour of inspection. They were fat, red-faced blokes, retired soapmakers or somethin' like that, an' their idea of an inspection tour was to bring a big hamper of lunch along, with some whisky an' champagne to wash it down with, an' eat lunch in the tunnel.

"WELL, the air pressure was so heavy the champagne cork wouldn't pop, but had to be pulled out, an' they were complainin' about how flat the stuff was. It wouldn't fizz at all. But they drank it, or one of 'em did. The other stuck to whisky, an' emptied about half the bottle. Then they went back to the air lock. I was goin' off shift, so I was in there with 'em.

"Pretty soon, as the pressure began to go down, the whisky-bottle cork blew out with a bang! The compressed air corked up inside of it got to work as soon as the outside pressure got lower than the inside. The cork just skipped one fellow's nose an' scared him stiff, but the other bloke was worse scared in a few minutes. Soon as the pressure got down toward zero, all that champagne he had inside of him began to fizz. He was frothin' at the mouth like a mad dog; an' talk about your colic! They had to send for a doctor an' an ambulance to take him home.

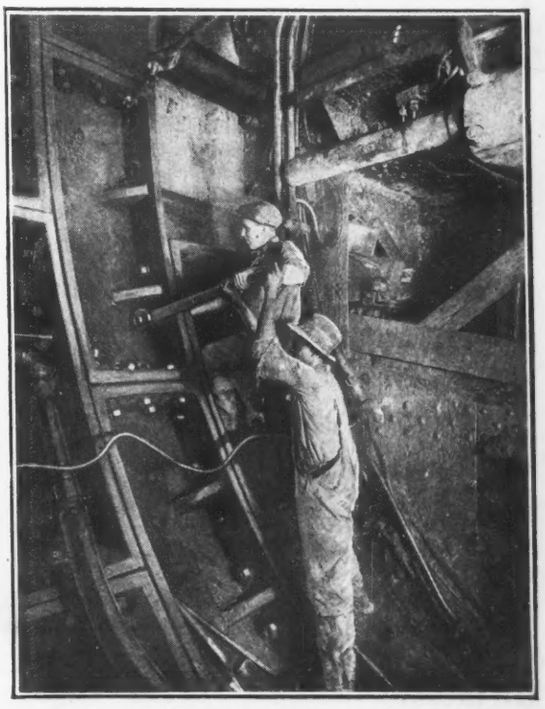
"OF COURSE," Paddy went on, with a touch of pride, "it ain't everybody that can stand the air at all. Some gets scared when they hear the roarin' in their ears when the air comes on in the lock. It's like goin' through the Long Island tubes in a train; there's some never learns how to blow out from inside to equalize the pressure on their eardrums, an' I've heard of men gettin' their eardrums broke, though I never knew one that did. I knew one lad, though, one of these structural-steel boys, that thought he'd like to be a sandhog. The first time in the air lock he blew so hard he broke a blood-vessel. He was no good.

"No, the worst danger is gettin' pneumonia. You see, it's hot under the air, an' you strip down to an undershirt an' a pair o' pants. Your blood is all full of oxygen an' you sweat like a horse. Then you come out of 90 degrees at the end of your shift an' maybe it's around zero outside, but you're so hot you don't notice it at first, an' you don't wrap yourself up like you ought to. Then you get a chill an'—good night!"

"But what about the risk of drowning?" I inquired. "Don't the caissons and tunnels get flooded, sometimes?"

"A fellow has to take some chances on any job," replied Paddy; "but it's no worse on this job than on any other—

(Continued on page 125)

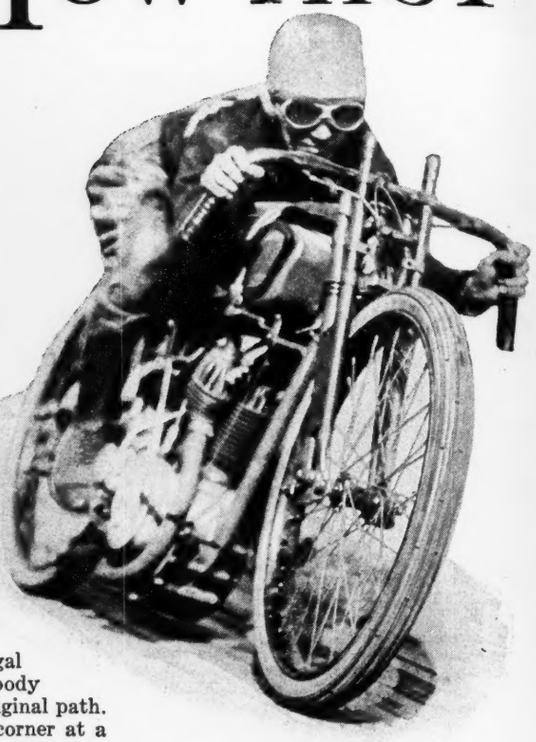


Sandhogs bolting together the great cast-iron segments that form the lining of the great under-river tunnel

How *FAST*

The Speediest of Swimmers

Johnny Weismuller is the world's speediest human swimmer; yet a fish could run circles around him. In his best effort he required 51 2/5 seconds in which to make 100 yards



Fastest on Two Wheels

Jim Davis setting the world's motorcycle speed record of a mile in 32.53 seconds. The motorcycle's possible speed, like the automobile's, is also limited by the road it has to travel

EVERYBODY who drives a motor-car or rides in one is familiar with the "speed limit"—the rate beyond which the law says a motor vehicle may not travel.

Has Nature, though, also her speed limit? Is there a rate beyond which a human being may not travel without breaking one of Nature's laws?

In other words, could a man operate an airplane or a motor-car at a speed of 1000 miles an hour, say, were science to produce a vehicle capable of going that fast?

It is doubtful, says science. The thousand-mile-an-hour airplane is mechanically possible, but there are speed limits set up by nature beyond which the human body cannot go. Various physiological processes of the body are the traffic cops that will force man to obey the speed laws of nature, no matter how fast he may build his vehicles, no matter how ambitious he may be to surpass previous speed records.

These physiological processes issue unmistakable warnings in the form of pain, dizziness, nausea, and even unconsciousness, when man approaches the speed beyond which he may not go. To proceed faster would be suicide.

WHEN Lieut. Al Williams, U. S. N., former big league pitcher, reached the unprecedented speed of 266.59 miles an hour in his airplane, not long ago, he heard the warnings of the traffic cops of nature.

"When I rounded a turn," he reported, "I went out cold."

And there, according to science, is the hub of the whole matter. The straightaway speed that man can stand may not yet have been approached; but it is likely that Lieutenant Williams came very close to the rate at which nature will permit a man to speed *and turn*.

For in turning there is developed a force called "centrifugal force"—the resistance that a body offers to deflection from its original path.

When an airplane turns a corner at a high rate of speed, it "banks." The pilot is thrown over on his side quite as abruptly as if he were cast from a catapult. The circulation of the blood must adapt itself to the sudden change of position. It is slow to do so. The body is going one way; the blood is circulating in a way that corresponds to quite a different motion of the body; the result is dizziness.

Moreover, centrifugal force draws the blood away from the brain. There results a condition known as brain anemia. At 266 miles an hour the brain's blood supply can readjust itself. At 1000 miles an hour, though, science says, the terrific pull would draw the blood from the brain with such force as to result in permanent injury, possibly death.

Major L. H. Bauer, of the School of Aviation Medicine, Mitchel Field, N. Y., is one scientist who is ready to predict that excessive speeds will cause permanent injury or death.

What nature's speed limit for the human body is, Doctor Bauer says it is impossible to state. But there is a limit, and probably it never will be reached because of nature's warnings.

When Al Williams made 266.59 miles an hour—a mile in a little more than 13 seconds—he traveled faster than a human being ever went before or since. Other aviators have approached that speed, but

More than Three Times Faster than Man

The racehorse Cherry Pie, which holds the world's record for a competitive mile, made this distance in 1 minute 35 2/5 seconds. Man's best record for the same distance afoot is 4 minutes 10 2/5 seconds

Can YOU Go?

New Discoveries Show that Nature, Not Mechanics, Limits Man's Speed

By Robert E. Martin

in no other vehicle has anything like such a speed been attained.

The closest approach to it, according to official records, is the mile in 23.07 seconds that Tommy Milton made in his automobile. Automotive engineers believe that automobiles never will travel much faster than that. It is not a question of making a car mechanically capable of attaining the speed; it is a matter of obtaining a road on which such a speed can be negotiated with comparative safety.

THE same factor probably limits the possible speed of motorcycles. Though motorcycles are used by the police in keeping automobile speeders in order, so far as speed records are concerned, the motorcycle must take second place to the automobile among vehicles that travel the road. For the fastest motorcycle speed recorded is a mile in 32.53 seconds made by Jim Davis.

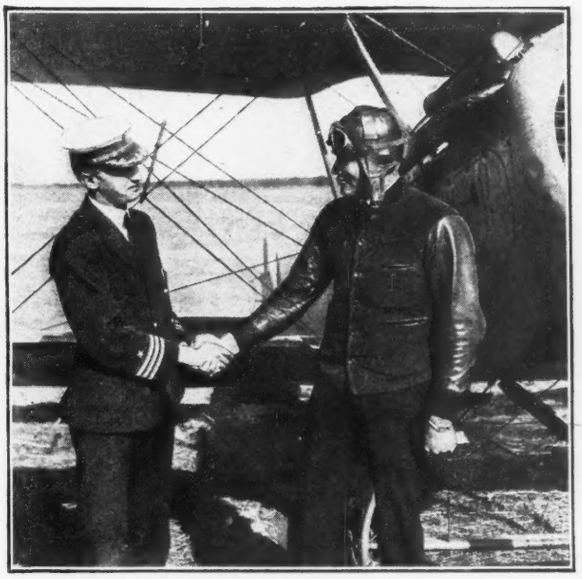
Mechanical vehicles—whether in the air, on the ground, or in the water—make the efforts of man to attain speed through his own muscles seem quite ridiculous. Thus, while man has succeeded in traveling a mile in approximately 13 seconds in an airplane and 23 seconds in an automobile, the best time that Paavo Nurmi, the last word in runners, has been able to make for the same distance is considerably worse than four minutes. Charley Paddock, probably the fastest consistent runner that ever lived, can better Nurmi's best speed, but only for a short distance. The dizzy speed that has carried this California athlete 100 yards in 9 3/5 seconds cannot be maintained by him for a mile—or even for an eighth of a mile, for the farther man goes, the slower he goes.

In the water, man's speed depends entirely on his method of navigation. In a motor-boat he can reach express-train speed. The speed of the greatest swimmer, however, cannot be compared with the speed of the average walker. Thus Johnny Weismuller, who has eclipsed all records at the shorter distances, required 51 2/5 seconds to make 100 yards in his best effort.

A fish, of course, could circle round and round this greatest of swimmers and beat him at any distance. Similarly, most animals can eclipse the best speed of which man is capable afoot. Thus, Cherry Pie, the racehorse, which holds the world's record for a competitive mile, accomplished the distance in 1 minute 35 2/5 seconds. Nurmi's best record for the same distance is 4 minutes 10 2/5 seconds.

With some mechanical aid, man can better that latter time. Thus, Reggie McNamara has gone a mile in 1 minute 45 seconds on a bicycle, while Arthur Staff has made a mile in 2 minutes 35 seconds on ice skates.

There seem to be very definite limits, though, to what man can accomplish with his muscles. Only a small fraction of a second usually separates the new record from the old.

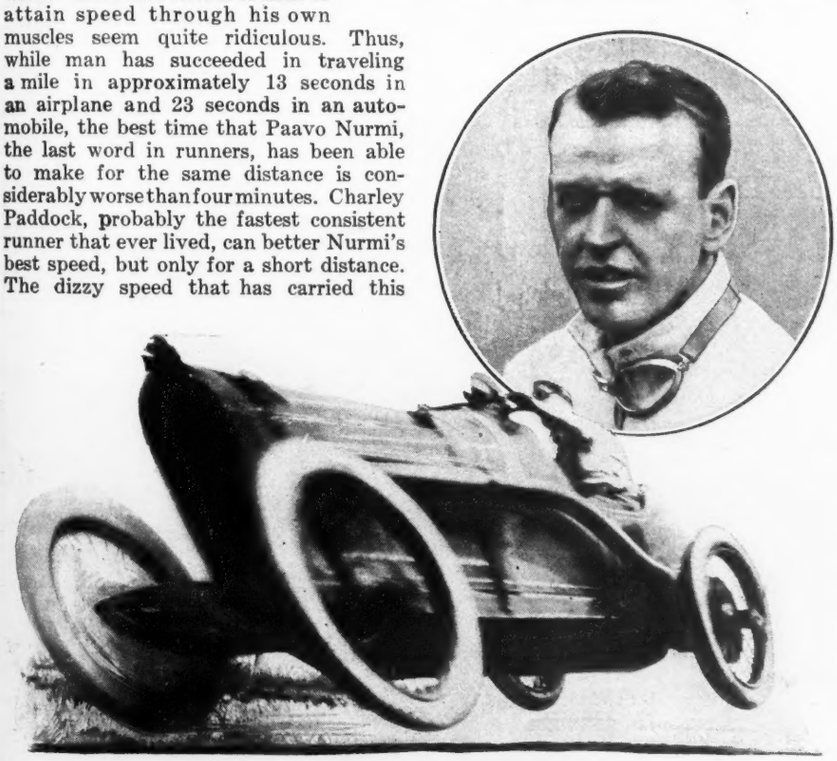


He Came Close to Nature's Speed Limit

When Lieut. Al Williams, U. S. N. (right), reached the unprecedented speed of 266.59 miles an hour in his airplane, he "went out cold" at a turn—evidence of nature's speed limit

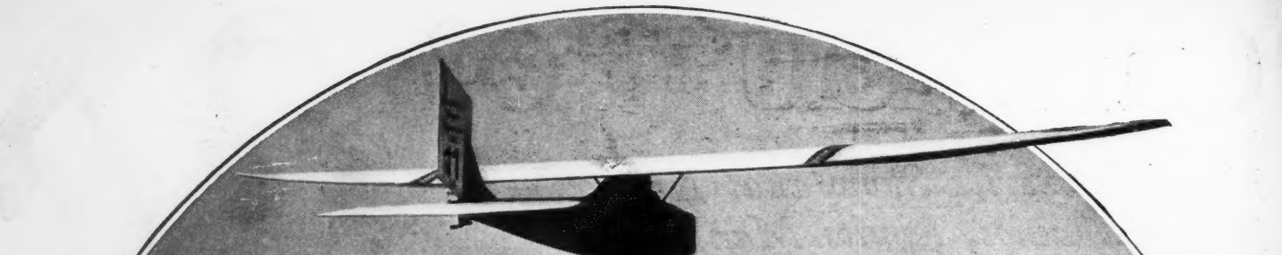
The Greatest Sprinter

Charley Paddock, probably the fastest runner that ever lived, has traveled 100 yards in 9 3/5 seconds; yet he could not maintain such speed, for the farther man goes, the slower his pace must become



His Car Traveled a Mile in 23.07 Seconds

The nearest approach to the fastest airplane speed is the mile in 23.07 seconds, made by Tommy Milton (above) in his automobile. Automotive engineers believe that automobiles never will travel much faster than this record. This remarkable picture shows Milton's car traveling at top speed



One of the new gliders soaring over the sea after a running start down a hillside against the wind

Sea Gliders—the Last Word in Aircraft

The pictures on this page were taken during a recent German contest for new types of motorless gliders capable of sustained flight and of alighting on the water. The picture at the left shows a biplane glider wrecked on the beach after the pilot had attempted a sea landing

Two contesting gliders in the air. The one at the left flew for eight continuous hours before landing

Above: A glider skimming the water's surface in making a perfect descent. At the right: How the contesting machines were hauled to the scene of competition by teams of horses. Note the absence of landing gear and the fishlike body of the glider, a monoplane

Poisons *that Lurk* in "Bootleg Booze"

Federal Chemists Reveal the Perils of "Imported" and Homemade Liquors

By Norman C. McLoud

LET the national water supply become as foul as bootleg liquor, and the population will be in a state of complete panic.

In this circumstance lies one of life's mysteries. Civilization balks at drinking polluted water. The mere suggestion of impurity brings consternation and dismay. A hint of typhoid germs in the water supply will terrify an entire community.

Bootleg liquor, though, is a different proposition.

Ninety-nine per cent of the stuff is off color. Much of it is the sort that kills. Not more than one quart in a hundred meets the standards of the days preceding prohibition. More than that, much of it contains actual, active poisons, among them carbolic acid, formaldehyde, pyridine, acetone, and iodine —chemicals that are used in denaturing the alcohol from which much of the bootleg stuff is fabricated and which the bootleg manufacturer cannot remove when attempting to turn the denatured alcohol into a beverage.

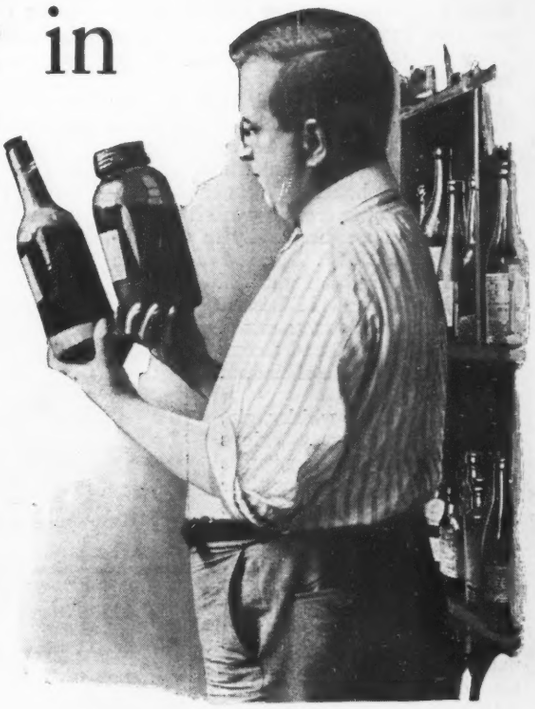
Lye is another poison that is found in bootleg booze. Lead salts, zinc salts, and tin salts, absorbed either from the distilling apparatus or from the containers in which the stuff is shipped, frequently appear in the weird liquors that are sold for genuine Scotch, rye, or gin.

And in spite of all this the public drinks the stuff and pays fancy prices for the privilege.

This is not propaganda. The statements are cold facts, stripped of argument, and based on scientific research. They are the product of applied chemistry seeking the truth about the national liquor supply. They are facts unbiased by personal opinion on the prohibition question.

There is a government laboratory in Washington that devotes itself to the job of learning what's in bootleg booze. I have lived with the chemists in this laboratory. I have seen them taste "bootleg"—as a part of their day's work—and spit it out as they would the rankest poison. In the process of observation I have seen them cheat death by seconds through the simple expedient of getting rid of the stuff before it could get them.

"We learn to taste without swallowing," government chemists explained to me. "Chemical analysis is exact, but there are some questions that it does not answer. The sense of taste must be employed also. We can taste the contents of 25 or 30 bottles without swallowing a drop. If we did swallow it, there would be daily vacancies on the payroll."



"Less than One Per Cent Is Genuine"

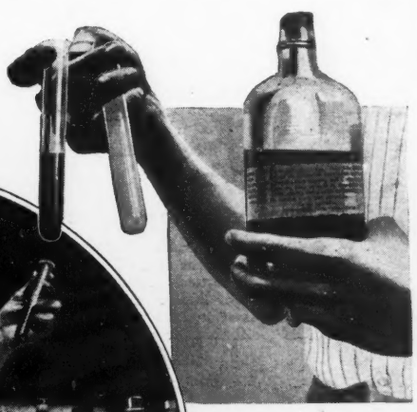
Dr. W. V. Linder, chief of the Chemical Section, U. S. Internal Revenue Bureau, examining typical specimens of moonshine. In the last year Dr. Linder and his chemists have analyzed more than 85,000 samples of bootleg liquor. "Less than one per cent of the stuff now sold," he says, "is genuine liquor"

In my study of contraband booze I have enjoyed contact with Dr. W. V. Linder, chief of the Chemical Section of the Internal Revenue Bureau. In the last year Doctor Linder and his chemists have analyzed more than 85,000 samples of bootleg liquor.

"LESS than one per cent of the stuff now sold," Linder told me, "is genuine liquor. Despite all you hear on the coasts about liquor that is 'just off a ship,' or in other parts of the country about liquor that has 'just been smuggled across the border,' or 'fraudulently withdrawn from a bonded warehouse,' bootleggers simply can't get hold of the 'real stuff.' The supply today is made up of moonshine, distilled under the most filthy and insanitary conditions imaginable, or mixtures of denatured alcohol, colored and flavored to represent whisky, or containing juniper to make it pass as gin. That this stuff is not as pure as before must be conceded.

"Poison? Of course. The degree of poison varies, but it is there just the same. Some of the stuff kills immediately. We have had gallons and gallons here, one drink of which might have meant death. Other mixtures might be drunk regularly for months perhaps before the poisons became effective. Sooner or later, though, they would become effective.

"The death certificate of the drinker might not show bootleg liquor as the cause of death, but it would be the



Spirits?

When poured from a bottle, this alleged "whisky" was pure amber, apparently a safe beverage. The addition of water, though, turned it a cloudy white, due to the presence of a poisonous denaturing agent

The Label Says "Scotch"

J. R. Young, government liquor tester for the last five years, is shown here examining a sample from a bottle bearing the label of a familiar brand of "Scotch." Analysis proved it to be poisonous

cause nevertheless. For the effects of many of these poisons are cumulative. They attack the liver or kidneys; undermine the entire system.

"It has been claimed that bootleg liquor is no more harmful in this respect than the alcoholic beverages consumed in other days. This contention, though, is wrong. The baneful effects of the present type of liquor are far greater."

Linder has a staunch ally in the official person of J. M. Doran, head of the Prohibition Unit's Industrial Alcohol and Chemical Division. Doran backs the statements of the chemical chief and makes startling declarations of his own.

"MUCH of the whisky, gin, and kindred drinks peddled by bootleggers," this expert told me, "have as their basis either moonshine, with its attendant poisons, or denatured alcohol, a non-beverage liquor intended for industrial use. The latter consists of pure grain alcohol to which has been added various denaturants rendering it unfit for beverage purposes.

"These denaturants are impossible of elimination by any process employed by the bootlegger. The majority of cases of instant death from alcoholic poisoning are the results of drinking this class of concoction.

"Wood alcohol produces paralysis and atrophy of the optic nerve, with total blindness, inflammation of the kidneys and bladder, nephritis, and cystitis In some cases it produces death. It is known that death has been caused by as little as three ounces. Detection of the presence of wood alcohol is impossible except by thorough analysis performed by a skilled chemist in a well-equipped laboratory.

"This product is diluted, flavored, and colored, bottled in containers bearing fake caps, labels, and stamps, and sold as well known brands of liquor."

IN THIS last statement is found the tack that punctures the consumer's bubble of security produced by familiar labels. Nobody should let himself be fooled by an honest appearance on the outside of the bottle. Counterfeit packages are the essence of the bootlegger's trade.

"Almost every brand of label has been imitated," Doran told me. "Whether domestic or foreign, the labels have been made and sold by the tens of thousands. Few labels known to American consumers have been overlooked."

One source of supply for fake materials was discovered in the shadow of the United States Capitol. In this establishment the representatives of the Treasury Department found a stock of merchandise that constituted a bootlegger's delight. There could be obtained any desired variety of bottle he might require—exact counterparts of the bottles that designated various brands before liquor became an outlaw.

Dressing the bottles received the same careful attention at the hands of this enterprising dealer. His counterfeits included labels, tinfoil, stoppers, and everything that might be required for giving the bottle an honest appearance. Even the packing was not overlooked. The supplies embraced the peculiar Scottish nails used overseas for fastening the cases in which Scotch whisky is packed for export. Straw wrappings were also on hand. The man who could see this merchandise and retain his faith in labels and appearances would be the world's champion dupe.

In the Storehouse of Fakes

J. W. Quillen, Uncle Sam's chief chemist in the New York laboratory, with part of his huge store of bottles. Many of these bottles bear familiar labels. Almost all of them, however, contain fake "booze," most of which is poisonous or unfit to drink

Even were you to see your "Scotch" come off a Rum Row ship, the government experts inform me, you have no guarantee that the stuff ever saw Scotland—or any other place beyond the famous three-mile limit. For the bootleggers have discovered that it is much easier and cheaper to manufacture their own "imported" liquor and then go through the motions of carrying it ashore from Rum Row than to handle the genuine stuff from abroad.

Not long ago a rum ship was captured, which contained a complete outfit for fabricating "Scotch" of almost any desired brand—There were alcohol, flavoring chemicals, bottles, labels, corks, cases; everything that was required to give the appearance of genuineness to the ship-made liquor.

From at least two points—one in New Jersey and the other on Long Island—bootleg "Scotch" made on United States soil, I am told, is transported regularly to the rum fleet by motorboat and carried back again by the rum-runners and disposed of as imported stuff.

THE bootlegger is a good advertiser. Much of his prosperity arises from stories sent broadcast regarding the large amount of liquor being smuggled into the United States, and similar stories of large amounts fraudulently withdrawn from bonded warehouses. These stories, though, Linder, Doran, and Roy A. Haynes, Federal Prohibition Commissioner, assured me, were made of the same material that supplies the body of much of the liquor that is peddled these days—moonshine.

"It is almost impossible to get real liquor," said Doran. "Even though it may have been real once, it does not remain that way for more than a few hours after coming into the possession of the bootlegger, for the bootlegger is not going to lose fabulous profits by selling good liquor 'as is' when he can dilute or 'cut' it with redistilled denatured alcohol, wood alcohol, or coloring matter, and make of it four or five times the original amount."

The possibility of getting "real stuff" from bonded warehouses, Prohibition Commissioner Haynes told me, no longer exists. All bonded stocks now are concentrated in a few centrally located warehouses to prevent leakage. Seven-eighths of the supply now is held in 30 concentration warehouses. Since this store was formerly held in 296 outlying places, the possibility of robbery or withdrawal by other fraudulent means has become negligible.

WHEN it comes to a question of "moonshine" the chemist has many fresh thrills. His schedule of what's what in contraband liquor now embraces the field of natural history as well as the catalog of poisons.

Snakes, lizards, rats, and bugs are some of the mildest of these ingredients. Actual poisons are among the most vicious. Between these classifications come many things varyingly repulsive.

"A serious problem is presented by the use of liquors distilled locally and at home," says Doran. "Alarmed by the recorded and published effects of wood-alcohol mixtures, a large element of the

(*Continued on page 132*)

Shoe-Leather *from the* Sharks

Remarkable Fish-Hide Industry Developed by New Process

THE increasing scarcity of mammal hides in recent years has caused leather manufacturers to turn to the sea for their raw product. Today, largely through experiments under the direction of the U. S. Bureau of Fisheries, the skins of sharks, porpoises, and other fish have been developed into excellent leather. For this purpose shark fisheries have been established on the Florida and Gulf coasts, and new industries are being established to utilize the new product.

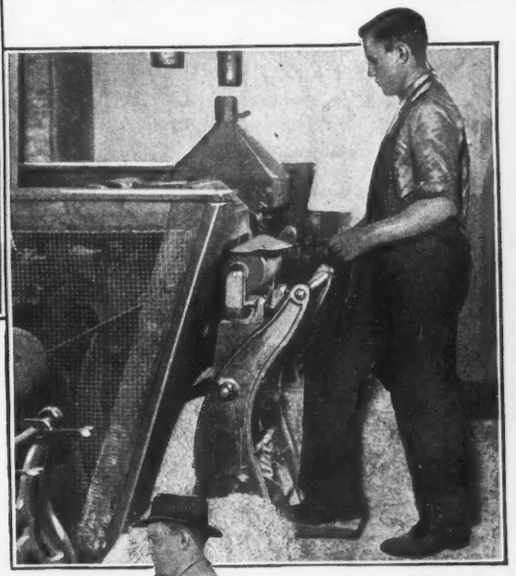
This has been made possible largely by a process of tanning developed in the laboratory of Dr. Allen Rogers in the Pratt Institute of Brooklyn, N. Y., and pictured on this page. One company, it is reported, now is turning out 200 shark hides daily. The hides are made into high grade waterproof leather that can be used just as ordinary leather. There is said to be as much leather value in a shark as in a cow, and the cost of a fish is far less.

Perfects New Tanning Process

Dr. Allen Rogers of Brooklyn, N. Y., discoverer of a new process for making commercial leather from shark skins, in his laboratory testing the finished leather

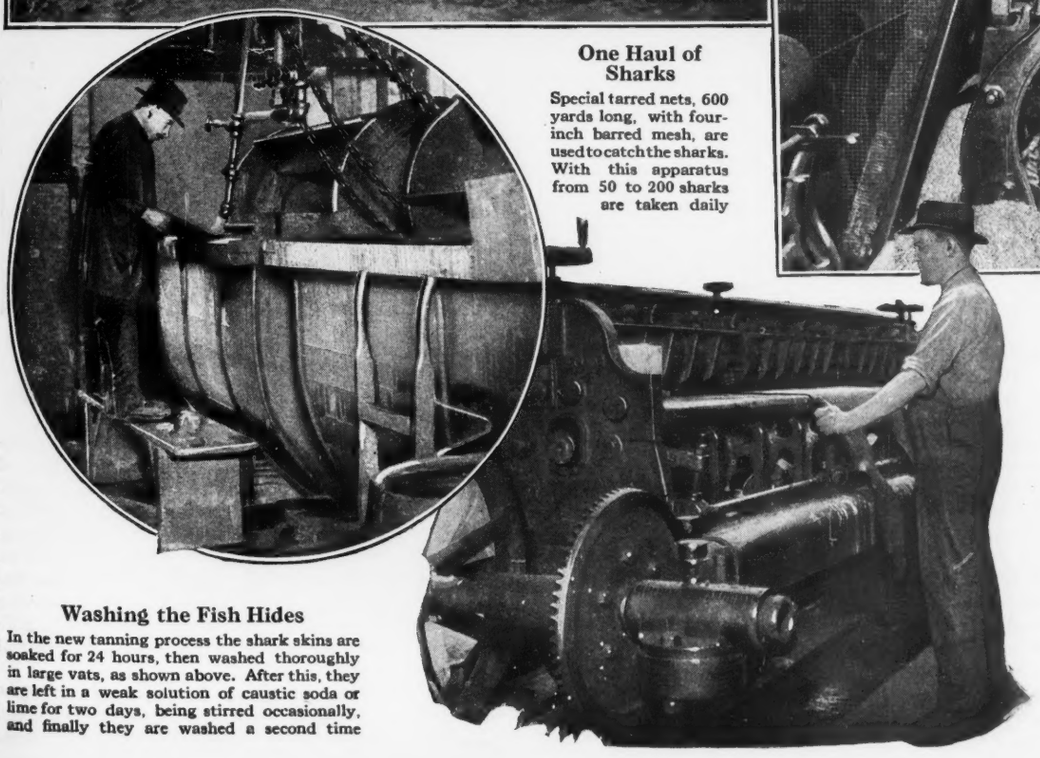
One Haul of Sharks

Special tarred nets, 600 yards long, with four-inch barred mesh, are used to catch the sharks. With this apparatus from 50 to 200 sharks are taken daily



The Polisher

After the skins are treated and dried, they are shaved on the grain side to remove coarse projections or denticles. Then, with the machine shown above, they are polished on a rapidly moving carborundum wheel



Washing the Fish Hides

In the new tanning process the shark skins are soaked for 24 hours, then washed thoroughly in large vats, as shown above. After this, they are left in a weak solution of caustic soda or lime for two days, being stirred occasionally, and finally they are washed a second time

Softening Hides

On the machine at the left the hides are made pliable. Some of them are given a gun-metal finish suitable for shoes. Others are tanned for lining leather and cordovan

LIKE a wild-animal trainer, in a cage full of potential death, "Slim" Hoffman makes high explosives obey his commands. His is the most dangerous job on the movie "lot." Upon his skill often depend the lives of hundreds of actors. "The only trick," he says, "is knowing what your explosive will do, then timing the mixture with the action of players and that of the camera."

He Has Staged More Battles than *Napoleon*

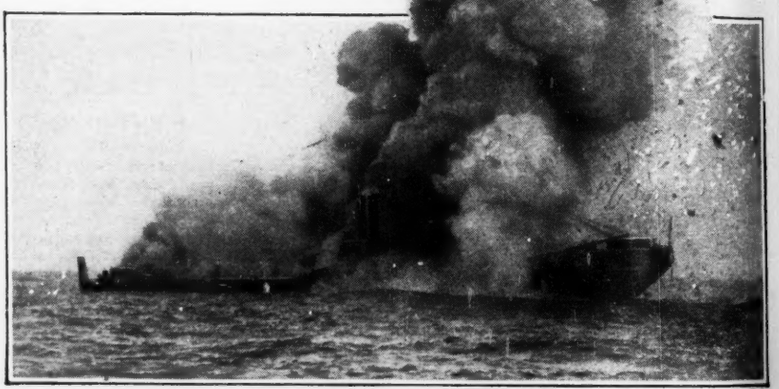
How "Slim" Hoffman Makes Dynamite Do Astonishing Tricks for Movie Thrillers

By Fred Gilman Jopp

A BLINDING flash lights up the inky horizon. Another! The shriek of shells with stunning crash of detonation. The numb earth throbs. Flames! Destruction! Horror!

The deathly silence that follows is broken only by the grinding click of cameras striving to catch the last thin wisp of smoke. The movie battle is over.

Not long ago a big freighter, formerly the S. S. *Corvallis*, sailed serenely off the coast of Sandy Hook. A man watched over a switchboard. He pressed a key. Half an hour elapsed, as the movie captions say, and floating bits of debris were the only token of the vessel that had been shattered and sunk. Ten tons of dynamite and 1000 pounds of gunpowder had done their work. All to provide a moment's thrill for you some night at the movies!



Blowing Up a Steamship for a Thrill

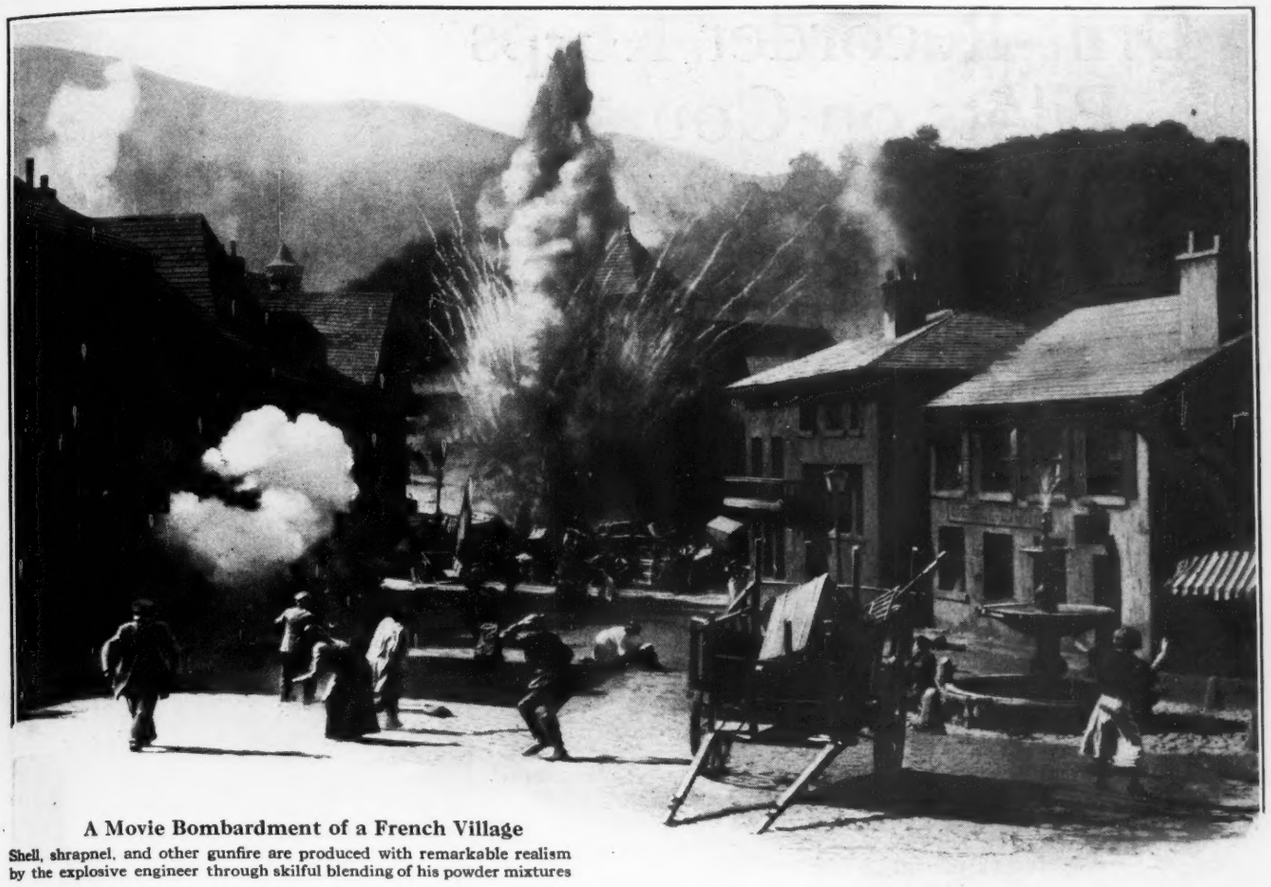
Ten tons of dynamite and 1000 pounds of gunpowder—set off by one man with the pressing of a key—produced this spectacular explosion of the steamship *Corvallis* a few weeks ago off Sandy Hook. And all to provide a moment's thrill for you in the movies

One man blows up a huge steamship. A single man creates the carnage of a whole battle—in the movies. He is a powerful person and important, for he plays with the most dangerous tools on the "lot." On his skill often depend the lives of hundreds of actors.

Here is the time to introduce Walter J. ("Slim") Hoffman, screenland's explosive engineer, the man who has staged more battles than Napoleon, but who differs from the Little Corporal in that he has yet to cause his first casualty. Hoffman can make dynamite do a whole bagful of tricks.

Everything has changed in motion-picture production, including methods of destruction. Movie sets used to be razed by pulling wires or cutting ropes. This never was satisfactory, because human beings all react differently. The pull on wires or the chopping of ropes never was uniform, and time after time a building would fall halfway and then stop in mid-air because some rope or wire had caught on a projection.

Then the method of using fuses came in. While this was an improvement, still it was unsatisfactory, because fuses



A Movie Bombardment of a French Village

Shell, shrapnel, and other gunfire are produced with remarkable realism by the explosive engineer through skilful blending of his powder mixtures

would go out at the wrong time. Often when a whole building was to be razed, one portion of it would remain standing because the explosive failed to explode. Accidents occurred from delayed fuses, causing serious injuries in some cases.

Today explosions are created by electricity and powder. All parts of a building can be destroyed simultaneously, or any portion of it without disturbing the rest. Or explosions can be timed to act consecutively, giving film effects that startle. So long as the powder is of a certain chemical quality a certain mechanical result is assured. There are no chances of accidents under these modern conditions.

The explosive engineer must construct a Civil War or a modern battle at three days' notice. The problems that greet him each day would drive another engineer crazy. An idea of what he is up against may be gleaned from the following assignments. The list is typical of the jobs "Slim" Hoffman finds waiting for him when he comes down to the lot in the morning.

1. Destroy the brick laboratory on the back lot without harming the two glass stages 100 feet distant.

2. An explosion in which a trick cigar explodes in the villain's mouth to blind him, and at the same time shatters the glass of poisoned wine held by the aged father.

3. A projectile breaking through one wall, must travel between two actors and out the other wall.

4. A man off balance, about to fall down a manhole, must be set back on his feet by the concussion of an explosion set off below. No tricks.

5. Destroy an entire French village with explosions that give the effect of shrapnel fire.

This is a good beginning. All the secrets of solving these difficult problems are locked away in the explosive engineer's brain. "There is really nothing to them," Hoffman told me with a laugh. "The only trick is knowing exactly what your explosive will do, then timing the mixture with the action of players and camera.

By ingenious placing of explosives, any part of a building can be destroyed without disturbing the rest. Behind the camera sits Hoffman, watching for the exact moment to throw the switch that will "shoot" an explosion where a moment before stood an actor

"THE great difficulty is with the human element. Powder will do what I command, but the players sometimes won't, and the result is grief, and lots of it. Actors, like almost all other people, have difficulty in mastering the psychology of fear. Any one can walk 20 feet on a curbstone, but lift that curb 100 feet in the air, and it's a different story.

"It is the same way with explosions. We can point out that the explosion will affect only a certain area, that physically it can spread no farther, but reasoning does no good when an actor is afraid. Usually, in such cases, the director and I get around things by keeping the explosion a secret. In this way I can guarantee positive results, and the director obtains registration of honest-to-goodness emotion. Imagine your favorite star standing near a couple of sticks of dynamite, and that dynamite exploding without her knowledge! Does she register fear and amazement? I'll say she does!

"The wise director, however, shoots the explosive scene at the very end of the picture, because after the explosion the star is likely to be a little shaky. And you can't blame her. But when this picture is shown and the critics rave over the star's great emotional work, you can

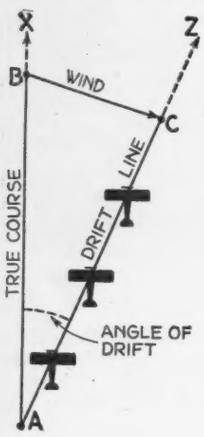
(*Continued on page 133*)

Drift-Recorder Keeps Pilots on Course

An Ingenious New Aid to Aviators

AVIATORS throughout the world are interested in recent successful tests of an instrument, invented by Commander Le Prieur of the French Army Aviation Service, that enables pilots to determine exactly the deviation of their craft from its course as the result of side winds. This instrument, called the "navigraph," makes it possible for the pilot to reach his objective in the shortest time possible.

The principle of the navigraph is explained in the accompanying diagram. Supposing an airplane should start from *A* on a course *A X*, with the intention of reaching *B*. If it were exposed during its flight to a side wind blowing in the direction *BC* the airplane would find itself at the end of a calculated time at *C*, having actually traveled along the drift line *AZ*, though pointed in a direction parallel to *AB*.



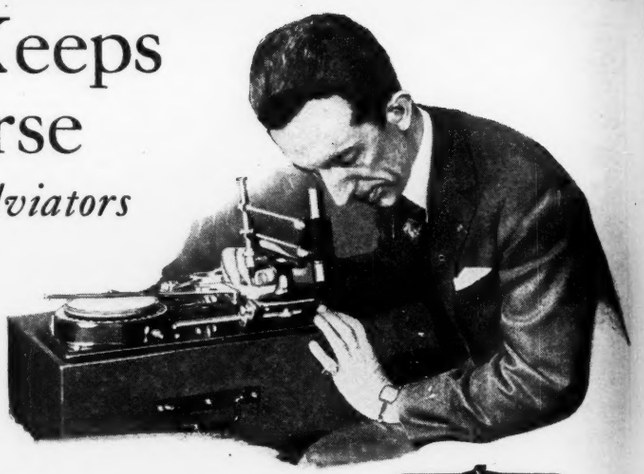
How an airplane, blown by a side wind, is carried from its true course *AB* along the drift line *AC*

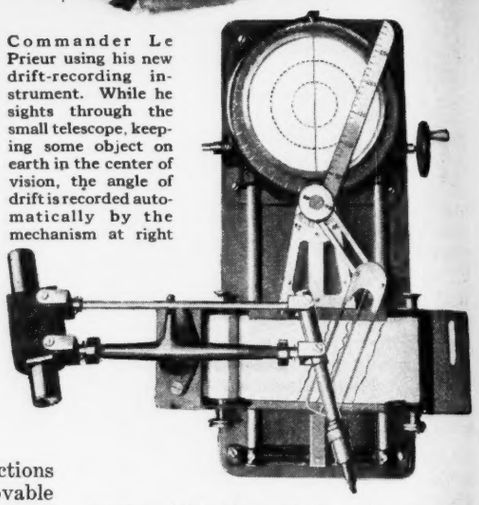
If we assume that the airplane, flying in still air, would have covered the distance *AB* in one hour, the line *AB* in the triangle would represent the speed an hour of the airplane. The vector *BC* represents the speed and direction of the wind in miles an hour, and the vector *AC* represents the course actually followed by the airplane and its speed an hour in relation to the ground. The angle *BAC* represents the deviation due to the wind.

Knowing the speed of his airplane and the direction and distance of his objective, the aviator needs only to know the angle and direction of his drift to enable him to lay out a course that will unerringly take him to his destination within a calculable time. The object of Le Prieur's navigraph is to provide a simple method of determining the drift angle.

The navigraph consists of an instrument for determining the direction and angle of side drift, and an apparatus for plotting corrections of the line of flight. A small movable telescope is mounted to form one side of an articulated parallelogram. The other side is formed by a tube with a pencil at one end. The axes of the pencil tube and the telescope always remain parallel. The point rests on a recording paper stretched between two rollers.

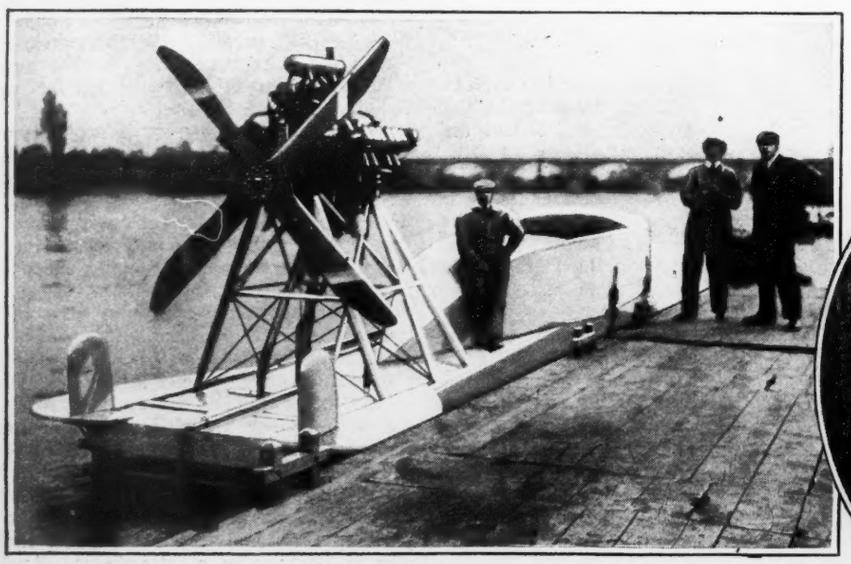
To determine the angle of drift, the aviator sights through the telescope some distant point along the line of flight. By keeping that point in the center of the field of the telescope, and drawing a line along the edge of the calibrated ruler mounted on a disk in a parallel position, the aviator will obtain a pencil-line record indictating the angle of drift.



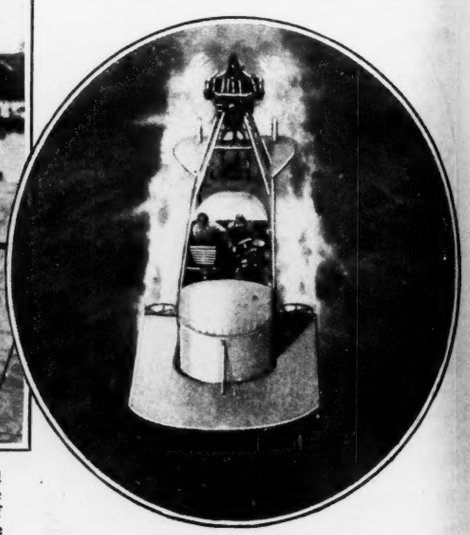


Commander Le Prieur using his new drift-recording instrument. While he sights through the small telescope, keeping some object on earth in the center of vision, the angle of drift is recorded automatically by the mechanism at right

French Air-Propelled Sea-Sleds Race a Mile a Minute



Below is a front view of the sea-sled speeding across the waves. The close-up view at the left shows how the motor and propeller are mounted securely on a framework above the stern deck of the flat, streamlined craft



While high power motor-boats have been matching their speed against express trains in the United States, a remarkable new type of racing craft, driven by airplane propeller, has appeared on the Seine River in France. It is called a "sea-sled." A number of these boats, racing under the auspices of the Motor-Boat Club of France, are reported to have attained the remarkable speed of a mile-a-minute

New Aids for the Deaf

Compact Amplifiers Replace Ear Trumpet

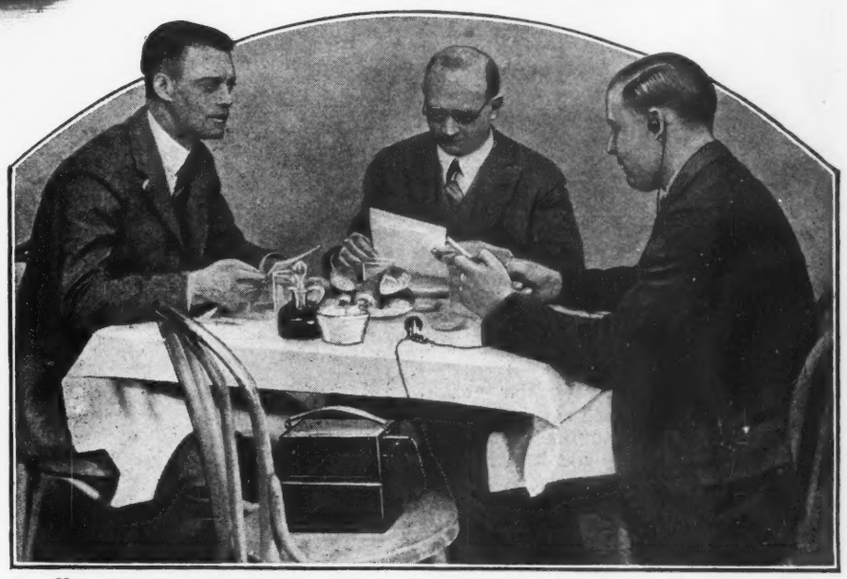
Dr. Byron E. Eldred demonstrating his remarkable new vibrating instrument for the deaf

TWO highly ingenious devices for the relief of the deaf recently have been developed by scientists.

Dr. Byron E. Eldred, mechanical engineer, of New York City, is responsible for the apparatus pictured above. The operation of this is based on the fact that deaf persons often can hear sounds ordinarily inaudible to them when the sounds are accompanied by loud noises, such as the rumbling of a train, or the beating of a drum. This phenomenon, scientists believe, is due to the fact that vibrations of the louder noises act as a sort of "carrier wave" for the smaller voice vibrations.

Doctor Eldred's device, by means of two generators that actuate a diaphragm, sends out a succession of air vibrations, corresponding to the rumble of a train or similar noises, and these are said to aid deaf persons to hear ordinary conversation.

Another device to aid the deaf is a miniature telephone receiver developed by engineers of the Bell Telephone Laboratories. This fits into the ear, and is virtually invisible. With its connecting cord it weighs only six-tenths of an ounce. It is connected with a microphone that can be worn in the coat lapel, and an amplifier in a box that can be carried in the hand. The amplifier contains two small vacuum tubes and the necessary batteries. By the use of this device, which is called the "audiphone," a person who has lost 60 per cent of his hearing is said to be able to hear the ordinary conversational tones of a speaker three feet away.



How the miniature telephone, called the "audiphone," is used by a deaf person. The instrument is so small that it fits in a person's ear. The amplifier is seen on the chair

Automatic Wireless Instrument Sends "SOS" Calls at Sea

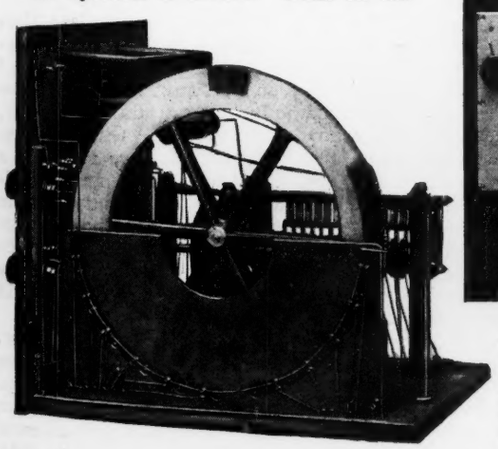
THAT the radio operator of a ship may have a chance for his life with the rest of crew if the vessel should sink, a new SOS sending device has been invented to give automatically the ship's call sign, the latitude and longitude, and the distress signal. After the machine has started it will continue sending out the call until the ship sinks, according to the inventor, M. Passaquin, a young French engineer.

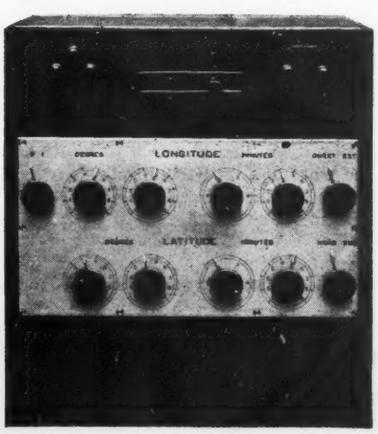
No operator is needed. Dials on the machine may be set each day according to the ship's location so that everything may be ready in case of accident.

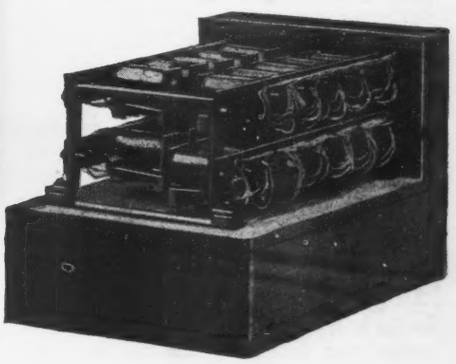
The instrument, operated by a small electric motor, is contained in a cabinet and may be mounted on a table. It consists of a wheel with notches all around its rim and a shaft bearing 14 cams.

The notches on the rim of the wheel transmit the three dots, three dashes, and three dots of the SOS signal. These are sent three times in succession, and then follows a long space that allows for the sending of the ship's call sign. The latitude and longitude are then sent by the cam arrangement, which has 14 cams, 10 for digits and four for compass points. The control panel is arranged with dials for the various settings.

Seacraft equipped with this invention does not need radio operators on board in order to send out messages of distress.







The control panel of the automatic SOS transmitter, with dials for the various settings, is shown above. Notches on the rim of the revolving wheel shown at left transmit the dots and dashes of the signal. At the right is an automatic receiving instrument

Sun-Gazer Forecasts Weather

Other New Discoveries and Useful Inventions that Mark the World's Achievements in Science

World's Most Powerful Magnet

For use in testing the atomic theory in metals, this huge magnet, said to be the most powerful in the world, was installed recently in the Engineering School of the University of California at Berkeley

ALMOST every day of the month there are produced new inventions or discoveries to lighten human labor, relieve suffering, add to our comfort, or increase our knowledge of the world we live in. Are you keeping in touch with them? Do you know of their value to you?

The following brief survey of the month's important achievements will help you keep up to date in the rapid progress of science and invention.

The Sun as an Almanac

ONCE every day for more than a year Henry H. Clayton, meteorologist, formerly official forecaster in Argentina, has been looking at the sun through a telescope, and forecasting, from what he has seen there, the temperature of the day one week following, in New York City. He mails his predictions to the Smithsonian Institution in Washington the day he makes them.

Recently, in checking up his method of forecasting weather by the sun, Smithsonian computers announced that for the year Clayton's predictions, on the average, worked out remarkably well. Bright patches on the sun, called "faculae," or numerous sun-spots, mean that a hotter sun is coming, Clayton explains. An increase of solar heating, contrary to what one might expect, means cooler weather in the East.

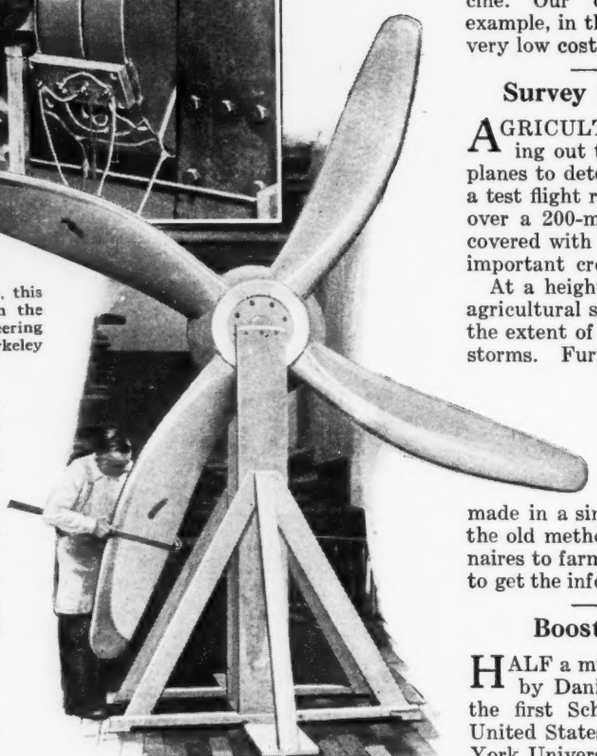
The methods of forecasting now employed by the U. S. Weather Bureau produce only general predictions of the "fair and warmer" type.

Antiseptic Rays Purify Water

TWO scientists in Paris recently dropped a bottle containing an antiseptic in a vessel of impure water. The bottle was tightly corked so that its contents could not come in contact with the water. Yet 24 hours later, when the bottle was taken out, 25 per cent of the microbes in the water had been killed.

The account of this amazing experiment conducted by Doctors Techouèyres and Bunau-Varilla was made recently before the French Academy of Sciences. An explanation advanced is that the antiseptic gives off rays that attack microbes, just as ultra-violet rays do. The tube that contained the antiseptic, a weak solution of chloride of lime, was made of quartz, which apparently let the rays through readily.

Out of 60 tests, 51 showed that the microbe colonies had been reduced nearly 30 per cent after 24 hours' exposure to the antiseptic, without contact. The consequences of this experiment may be of great importance for hygiene and medicine. Our city drinking water, for example, in the future may be purified at very low cost without chemicals.



The Biggest Airplane Propeller

Measuring 16 feet across, this immense airplane propeller was constructed recently in Milwaukee, Wis., for one of the planes that soon will attempt a round-the-world flight from Seattle. It is declared to be the largest aircraft propeller ever built, and is designed to travel 1200 revolutions a minute

Survey Crops by Airplane

AGRICULTURAL observers are trying out the plan of going up in airplanes to determine crop conditions. In a test flight recently, an army plane flew over a 200-mile area in North Carolina covered with tobacco, peaches, and other important crops.

At a height of from 50 to 200 feet an agricultural statistician was able to note the extent of damage done by insects or storms. Further, he was able to determine by the color of the crops and soil the general healthiness of the crops.

In an airplane an estimate of crop conditions over a large area can be made in a single day, it is said, while by the old method of sending out questionnaires to farmers, it often takes 10 days to get the information.

Boosting Aeronautics

HALF a million dollars has been given by Daniel Guggenheim to establish the first School of Aeronautics in the United States. It will be a part of New York University in New York City.

A $24,000 prize is being offered in England for the design of a moderate priced, low powered, light airplane for popular use. It must be a two-seater, dual-control plane of British construction, with folding wings and an engine that weighs not more than 170 pounds.

Coffee and Alcohol

COFFEE is more of a stimulant than alcohol. The latter makes a man stupid. It is depressing and paralyzes all proper fear and restraint. While those under its influence can do more work, they do not do it well. On the other hand, coffee is stimulating, enabling a user to work beyond normal strength, although he must pay the penalty later in loss of sleep. These statements were made by Dean Henry H. Rusby, of the Columbia College of Pharmacy in New York City, explaining why the world drinks what it does.

Another Columbia University professor, Dr. H. L. Hollingworth, put six college students to a two weeks' drinking test to find an answer to the question: When is a man intoxicated? In courts all sorts of tests are used, from making a man

walk a chalk line to repeating the alphabet backward.

Alcohol was included in the students' diet on certain days without their knowledge, and their conversation, conduct, appearance, and attitude were observed carefully. The results showed, according to Doctor Hollingworth, that psychological tests are the best method of detecting intoxication. These measure steadiness, speed, and control by testing the subject's ability in such things as tapping with a pencil and adding.

Catfish Lives 50 Years

HOW long does a fish live? Not out of water. Any boy can tell that from observation. But with proper food—everything it needs?

Major F. S. Fowler, of England, who has been conducting a special study to find out, reports that a catfish with which he is acquainted is now 50 years old and is still lively. An electric eel in the London Zoo, he found, lived 12 years. Other fish age figures, as given by Major Fowler, are as follows: carp, 13 years; goldfish, 12 years; herring, four years; salmon, three years; brown trout, six years. A bullfrog's recorded age was 15 years; toad, 11 years, and the giant salamander, 52 years.

Lung Capacity and Health

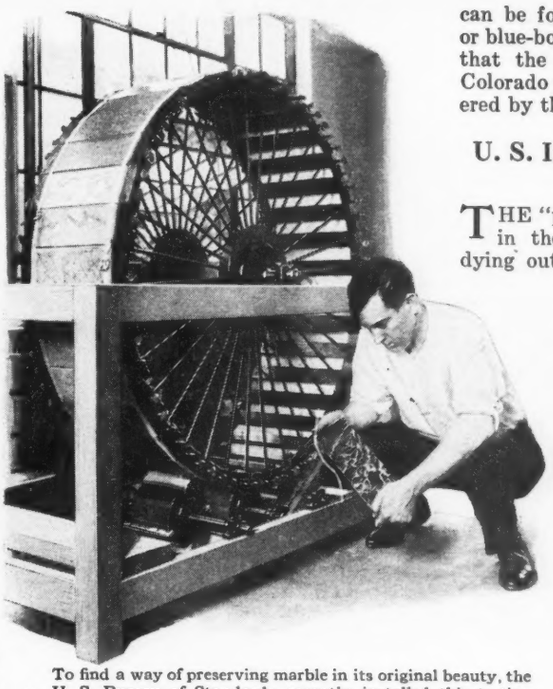
PUFF out your chest, but don't be too proud of yourself. Large lung capacity does not mean, necessarily, that you are healthy. Dr. J. A. Meyers, of the University of Minnesota Medical School, reporting the results of six years of study of lung capacity, says that it is by no means a certain test.

The man with the barrel chest may have done hard labor, engaged actively in athletics, or sung baritone in the choir. Any of these things would have increased his lung capacity. At the same time his lungs may be diseased.

Many persons who were known to have 125 per cent or more of normal lung capacity, Doctor Meyers' study revealed, developed diseases of the heart or lungs. Later examination showed the disease decreased the lung capacity of the individual, while it still left him with more than 100 per cent, or normal, capacity.

Insects of Past Ages

TSETSE flies, carriers of the germ of sleeping sickness, fatal to men and cattle, have been found in Colorado. Fortunately, they are dead and have been so for one or two million years. They are fossils, found recently in rock deposits near the foot of Pike's Peak by expeditions under T. D. Cockerell of the University of Colorado. Strangely enough, not a trace can be found of house flies, stable flies, or blue-bottle flies. There is no evidence that the monster beasts roaming over Colorado in prehistoric days, were bothered by these pests.



To find a way of preserving marble in its original beauty, the U. S. Bureau of Standards recently installed this testing machine, which subjects samples of marble tiling to vigorous scrubbing with various cleaning fluids. D. W. Kessler, in charge of the laboratory, is seen holding a piece of the marble in his hand after it had been cleaned in this way

U. S. Indian Population Gains 22 Per Cent

THE "poor Indian" is holding his own in the United States. Instead of dying out, as is popularly believed, the Pueblos and other tribes are increasing at a rate nearly as high as that of the white population.

A census just taken shows that in the last 10 years the population of Pueblo villages increased more than 22 per cent. During that same time the entire population of the United States increased 39 per cent, and part of that was due to immigration.

Dr. Edgar L. Hewett, a well known archeologist, who has been studying the Indians, denies that disease is appallingly prevalent.

"Banana Myth" Refuted

WHEN Columbus arrived in America, there were no bananas here. They were introduced 24 years later from the Canary Islands. Early migrants carried them to the Pacific Islands, but they first grew in the Malay Archipelago on the other side of the world.

Doctor W. E. Safford, economic botanist of the U. S. Department of Agriculture, made these statements recently in refuting what he calls the great "banana myth." That is, that bananas originated in this hemisphere and were cultivated here in prehistoric times by the Indians.

Hate of Noise Won Him a Fortune

Alden L. Putnam, of Lansing, Mich., inventor of the popular balloon tire

BECAUSE he hated noise, he patented one of the world's richest inventions. Alden L. Putnam, of Lansing, Mich., invented balloon tires to stop the chatter of his car.

Reared in the peaceful New England countryside, he enjoyed quiet instinctively. And so later, when he drove his car over railway tracks or uneven roads near Detroit, the rattle of the machine irritated him. As superintendent of an automobile factory he did his best to quiet the noises of cars turned out of the plant.

During the war Mr. Putnam served with the U. S. Motor Transport. The noise of the heavy army cars exasperated him. Finally, one day, he gave a tire a spiteful kick. It replied with a loud thump.

The inventor rushed back to his garage. He had discovered the source of road noise. He put huge tires on the wheels of his car—34 by 7 inches. The rims were not made for these, and the tires were ruined. He tried another set, and persisted until he had perfected his big tire.

Mr. Putnam applied for a patent on his balloon tires in 1920, but it was granted only this year. Within the last 18 months balloon tires have become standard equipment, and from his passion for quiet it is predicted the inventor will reap a fortune.

New Method of "Painting"

"PAINTING" buildings with light is an inexpensive and effective method invented by engineers in Fresno, Calif. The walls are made of cream-tinted terra cotta or pressed brick and flood-lighted with colors such as soft magenta, ruby, or emerald. Wonderful "dream pictures" are said to result.

Ancient Bread

LOAVES of bread 2000 years old were dug up recently in Egypt.

Ingenious Revolving Eraser Holds Paper Cutter

FOR draftsmen, architects, builders, typists, and others who have occasion to make frequent erasures, sometimes from important papers, a new type of revolving eraser has been invented by James F. Hayes of Chicago. Pressing the thumb on a plunger produces an erasing surface of more than four inches.

An attachment to the eraser sharpens pencils, opens envelopes, cuts paper, and erases ink.

Chance Leads to Valuable Find in Tire-Repairing

EMIL NESTLER, of New York City, bought a new car that had gone through a fire. The tires, as well as the body of the car, were somewhat damaged by fire and in attempting to repair these burned tires, Mr. Nestler had a curious experience. One of the five tires gave remarkable results after he had retreaded it, but the others suffered from the loose treads that so often end the usefulness of retreaded tires.

In experimenting to find out why the one tire should lend itself so readily to a retreading job, Mr. Nestler stumbled on a process for retreading tires that appears to eliminate the many defects in former processes. The chief trouble always has been the difficulty in keeping the new tread from parting company with the carcass of the tire. By Nestler's process the surface of the old rubber is reduced to unvulcanized rubber so that when the new tread is applied and the tire revulcanized, the new rubber fuses with the old and a perfect bond is formed.

The inventor, Emil Nestler, demonstrating his new process of retreading. The new and old rubber fuse

Electric Pointer Illuminates School Map

MANUAL-TRAINING students at a Cincinnati public school built this map of South America. When the teacher presses a switch, all of the sections of the country producing rubber, say, are lighted up simultaneously. There are switches for nitrates, fruits, silver, and other products of the southern continent.

The map is used in studying economic geography in this case, but of course other classifications and arrangements of switches could be arranged.

Electrically operated map in classroom of a Cincinnati school. Pressure of electric switch at bottom of map illuminates section of the country that is the subject of class study.

EVERY person in the United States has the equivalent of 48 slaves. There are 700,000,000 mechanical horsepower developed in this country and the average work capacity of one human being is one-eighth horsepower.

Hat Held On by Vacuum Button when Wind Is Blowing

A CLEVER manufacturer has devised a means whereby he claims a straw or felt hat sticks to the head, tight as a mustard plaster, in a stiff gale. The device consists of a small molded button fastened to the hat through a buttonhole in the front of the sweatband. When the hat is placed on the head, the button sticks to the forehead on the vacuum principle. The grip is out of sight when worn, and is said to be comfortable.

German Zoo Uses Rum as an Anesthetic for Animals

WILD animals in captivity occasionally require surgical operations, and until recently the accepted practice of the veterinarians who performed them was to use chloroform for an anesthetic. Animal surgeons in the famous Hagenbeck Zoo, near Hamburg, Germany, however, have discovered that animals submit to surgery better when drunk than when subjected to the usual anesthetics.

Accordingly, when now a lion, or a tiger, or a hippopotamus needs a little dental work or other surgical attention, it is fed huge quantities of rum or cognac. Then, when it sinks into a drunken stupor, it is chained, and the surgeon performs his work with no pain to the patient or danger to himself.

Scientists on the Trail of a New Element

THE announcement was made a few weeks ago that three German chemists, Drs. Walter Noddack, Ida Tacke, and Otto Berg, have discovered two of the remaining unknown elements of the periodic system, Nos. 43 and 75, and have named them "masurium" and "rhenium." Both elements are exceedingly rare and constitute one-billionth part of the earth's crust. Hafnium, No. 72 in the total list of 92 elements, was discovered about a year ago. Numbers 61, 85, and 87 still are unknown.

The element No. 61 is believed to belong to the rare earth metals. Doctor Lapp, a noted American chemist, has succeeded in observing faint lines of the spectrum of element No. 61, and it is highly probable that the element will be isolated in the near future.

A New Distress Signal Fits in Palm of the Hand

Simple distress signal

HERE is a brand new distress signal called the "stressnal." With it you may scare away a bandit or burglar, but it can't hurt him. It makes a lot of noise by firing blank cartridges—10 of them—in rapid succession, and its inventor claims that the noise is heard easily half a mile away.

This big surprise for the hold-up man fits in a woman's purse and may be carried in the palm of the hand ready for action as pictured. Pressing the button with the finger starts its rapid-fire action. If you let it drop from the hand it keeps on firing and the would-be bandit flees in terror.

Removing two small screws opens it for reloading with 10 more blanks, and then it is ready for another attack.

Folding Baby-Carriage Fits in Suitcase

The folding carriage as a dolly buggy. The upper picture shows the small size into which the carriage collapses

A BABY-CARRIAGE that, when folded, can be carried like a handbag or in a suitcase is the latest development of the collapsible carriage. The "Dinkie," invented in England, weighs only 14 pounds. The body is of pliable waterproof material, supported by a rigid framework.

It can be used, also, as a go-cart, a cot, a high chair, or baby's bath. Thus a father can carry in one hand furniture enough for baby's needs during the week-end outing.

A NEW method of mosquito prevention consists in mixing oil with sawdust which, when "sowed" on the water, sinks, and releases oil for four or five days.

Engineers Move a 280-Foot Bridge in London

IN THE rebuilding of the famous Waterloo Bridge in London, a remarkable engineering feat was accomplished recently, when a 280-foot span of the temporary steel bridge was moved bodily for a distance of 93 feet.

The span was moved along steel girders by eight men turning winches that slid the giant framework and its 500 tons of weight at the rate of four feet an hour.

The historic Waterloo Bridge, which has been weakened by the sinking of its central piers may be destroyed.

Disk Points Warn of Poison Bottle in the Dark

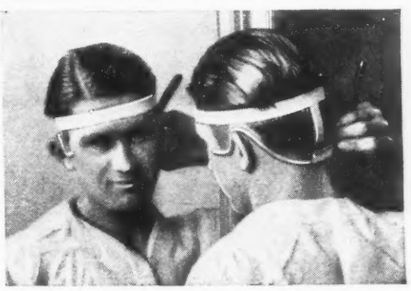
A PRICK means "look out." Fumbling in the dark through the medicine chest, where poison should not be kept, but often is, a person cannot make a fatal mistake if the poison bottle is equipped with the new type of safety bottle-stopper illustrated.

The warning comes from a metal disk with sharp projecting points, which is held to the bottle by pushing the cork through it.

Danger in Spoiling Your Dog

TREAT your dog as a dog and not as a human being, warns Dr. Minas Joannides of Minnesota. Dogs may carry tuberculosis, diphtheria, scarlet fever, measles, smallpox, and rabies. They are subject to tapeworm and often carry fleas, ticks, and lice.

If you make a dog a member of your family, be sure to keep him clean and train him to avoid contact with infected materials, says Doctor Joannides. Don't let him eat off your plate.



Homemade Haircut Improved by Neck-Shaving Guard

IF YOU could manage to shave the back of your neck, the home barbering stunt would almost pass as professional. Getting their wives to do it is the solution for some men but, in strict confidence, this doesn't always work out satisfactorily.

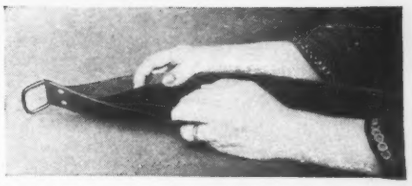
W. C. Bridges of Muscatine, Ia., has invented a neck-shaving guard to solve the problem. It consists of wire adjustable to any desired shape of neck trim. The wire is covered with a rubber tube, and is held in place by an elastic band that fits around the head.

Offers Huge Cash Prize for Morphine Substitute

ONE hundred thousand dollars is the dazzling prize offered chemists to induce them to discover how to manufacture a cheap substitute for morphine. The discovery must be made within the next five years. Herman A. Metz, of New York City, is making the offer in the hope of doing away with the drug evil.

Morphine is now derived from opium. If it could be made synthetically, much cheaper than that derived from the poppy, Mr. Metz believes that the supply of opium would be killed at its source. It would no longer pay to grow the poppy.

The magic formula, if discovered, must be guarded very carefully to keep the drug from being manufactured and spread among addicts.



Six-Surface Razor Strop Lasts a Lifetime

THE difficulty of keeping the surface of a razor strop in good condition has been solved by an English inventor, who has designed a razor strop with six surfaces actually forming three strops in one. When one section has worn out, it is cut off at the ends, and the next section used for stropping.

The base of the strops is made of a fiber composition specially treated with a dressing that is said to give the razor a good edge without injuring the blade. The inventor claims that this many-sided strop will give a lifetime of service to the user.

Jumping-Jack Shoes Provide Thrills for Children

LEAPING through the air like a kangaroo is the exciting sensation offered to children by the recent invention of shoes with springs. These novel exercising toys are strapped to the feet in the same manner as roller skates, and the wearer can walk, run, jump, or dance on them.

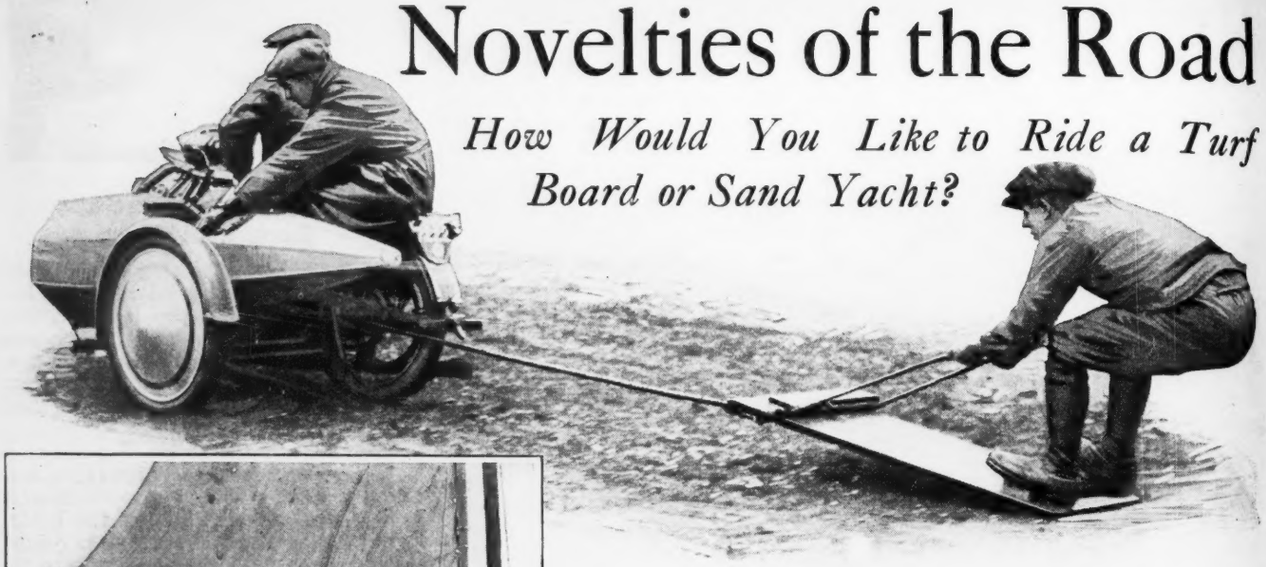
The steel springs, while of unusual strength, are extremely elastic. The effect produced is said to be like walking on air. Each shoe has two spiral springs. The lower end of each spring is fastened to a sole that prevents the springs from injuring carpets or marring floors.

With a little practice, it is said, a child can make enormous leaps.

Boys using the new spring shoes to play "leap-frog." Notice the soles attached to the bottoms of the springs to give sure footing and prevent floor marks

Novelties of the Road

How Would You Like to Ride a Turf Board or Sand Yacht?

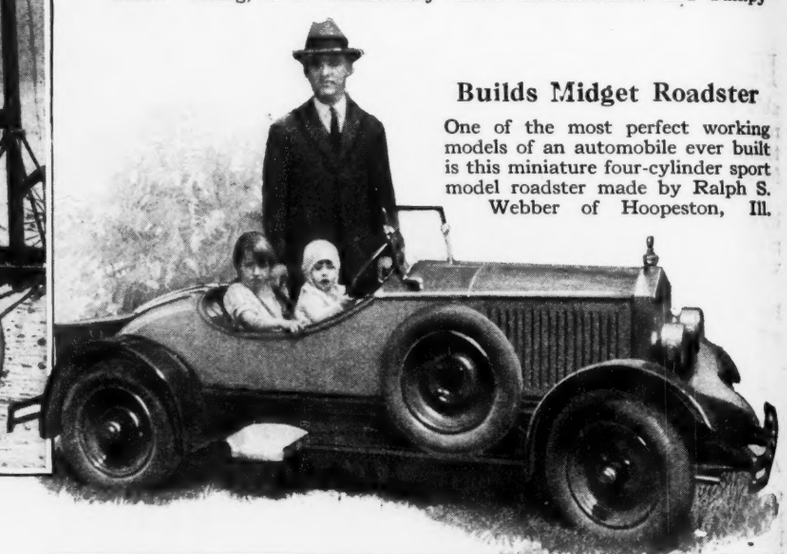


"Turf-Board" Riding Newest Motor Sport

At a recent cycling exhibition at the Crystal Palace, London, participants displayed their skill on surf-boards attached to motorcycles. While "turf-board" riding is said to be not quite as difficult as "surf-board" riding, it is considerably more uncomfortable and bumpy

Sand Yacht Runs on Wheels

Clipping along through the salty spray, Miss Joan Mitchell, an English golf star, drives her rubber-tired "sand yacht" over the wet, smooth beach at Ayling. Her pet dog rides in the small back seat



Builds Midget Roadster

One of the most perfect working models of an automobile ever built is this miniature four-cylinder sport model roadster made by Ralph S. Webber of Hoopeston, Ill.

A Mechanical Roadway

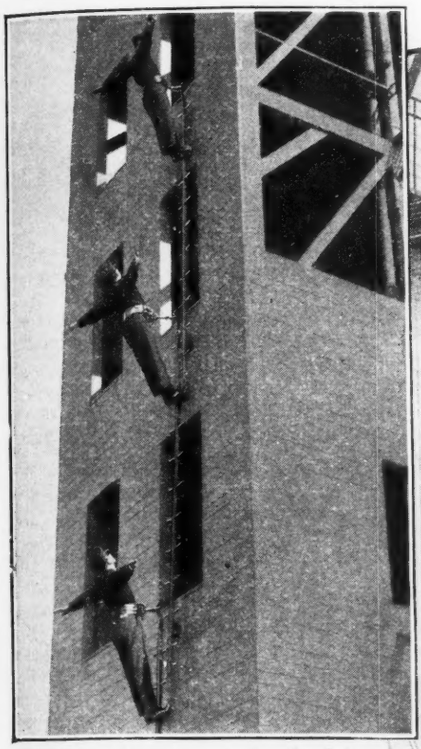
This "mechanical highway," consisting of four rollers under the rear wheels, facilitates adjustments under load

Traffic Signal also Supplies Time Warning

By a mechanism that slowly draws a veil over the "stop" and "go" signs, this new traffic signal tells drivers how much time is left to cross the street before the stream of traffic will start in the opposite direction

Where Fire-Fighters *Go to* School

Thrilling Feats Test Their Nerve



Having mastered the use of scaling ladders, pupils in the Fresno firemen's school learn to support themselves on the ladders with both arms free, using safety belts fastened to the ladder as pictured above

Above: How the fireman learns to carry an injured comrade down a life rope from an upper floor of a burning building. Center: Jumping into a life net from a sixth-story window

THE fire department of Fresno, Calif., claims the distinction of having the only school for the training of firemen outside the City of New York. Before any applicant can go on the payroll as a full-fledged member of the department, he must pass through weeks of intensive training in breath-taking feats of rescue. He must learn to scale the walls of skyscrapers with steady nerves; to carry the dead weight of human bodies down from precarious heights on swinging ropes; and to jump from sixth-story windows into a life net that is spread below.

A few of the daily paces that not only test the courage of novices, but train them in the science of fire-fighting, are pictured above.

Miss Liberty All Dressed Up for Birthday

AMERICA'S Goddess of Liberty has been granted independence. Congress decided recently to designate the statue as a national monument and make a special appropriation for its upkeep. Before this, the great torch in New York Harbor, given to the United States by France, was under the custody of the Quartermaster's Corps of the U. S. Army.

Miss Liberty's yearly allowance will be about $7000. Ninety per cent of this is needed to pay her lighting bill. Two hundred and fifty-six flood lights flash on every evening as the sun sinks below the horizon. These go out at 11 o'clock, but the torch remains illuminated until sunrise.

An airplane view of the Statue of Liberty on Bedloe's Island. At right electricians are seen working on the huge torch held in the hand of Liberty

To celebrate her fortieth birthday, her custodians decided to give the goddess a bath. Steeple-jacks and other aerial acrobats were hired and she was scrubbed thoroughly from her gigantic head to her massive feet with brushes and heavy streams of water until she shone.

Railroad Runs Buses

THE New York, New Haven & Hartford Railroad has gone into the motor business and will operate bus feeder lines to the railroad in Massachusetts, Rhode Island, Connecticut, and New York.

New Type Battering-Ram Aids Firemen in Fighting Blaze

FREQUENTLY the hardest part of the fireman's job is to get at the fire so as to be able to play the hose on it. This novel two-man battering-ram has been developed by the New York Fire Department for use when it becomes necessary to batter through a wall or ceiling in order to get at the fire.

Ordinarily, an ax can be used for this purpose if the structure is of wood, but the heavy battering-ram will be far more effective than an ax for use on concrete and steel construction. Practical tests by the Fire Department already have demonstrated the remarkable efficiency of this device.

New Synthetic Motor Fuel

ONE more fuel possibility is a new synthetic alcohol known as "methanol," imported from Germany. It is a wood alcohol produced from coal and water, and is a result of researches carried on in Germany during the war, to find a substitute motor fuel.

Pipe-Wrench Has a Reversible Jaw

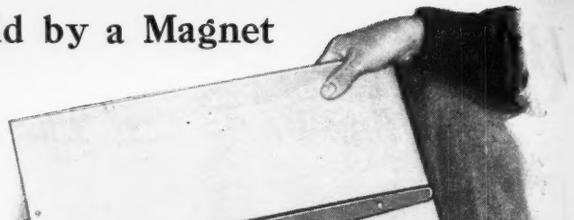
IT IS claimed that the pipe-wrench shown at the right will turn a pipe in either direction with ease, no matter how tightly it is set. The jaw can be taken out and reversed so that it is an easy matter to get at any pipe, even when it is placed very close to a wall, ceiling, or floor or when it is jammed up against other pipes.

COAL-MINE explosions are most likely to occur between six and nine A.M., and between three and seven P.M.

An adjustable jaw makes wrench especially useful

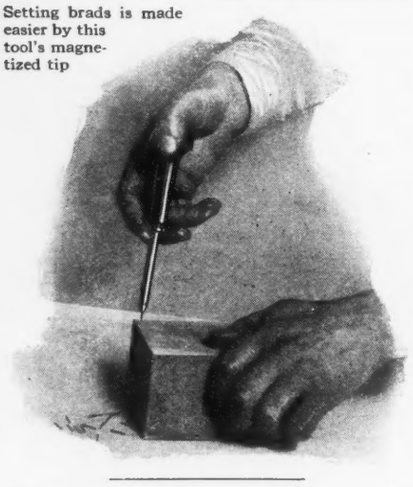
T-Square Held by a Magnet

THE short cross piece of this remarkable T-square incloses a powerful permanent magnet. A piece of steel is set into the edge of the drawing-board and ground absolutely flat and square. The magnet is so powerful that it is claimed it will hold the T-square tightly in position even when the drawing-board is held up edgewise as shown in the illustration at the right. Because of the smoothness of the steel surfaces, it is said that the T-square can be moved along the drawing-board just as easily as without the magnet.



T-square is held to drawing-board by magnetized cross pieces

BONES discovered in volcanic ash in Montana, show that tapirs and rhinoceroses once inhabited that region.



Setting brads is made easier by this tool's magnetized tip

Brad Setter Eliminates Hammer when Fastening Packing-Box

CONCEALED inside this remarkable little tool is a powerful magnet. Pulling the outside sleeve toward the handle with the first two fingers exposes the end of the magnet and when the magnet is touched to the head of a brad and the sleeve released, the magnet draws the brad into the tube.

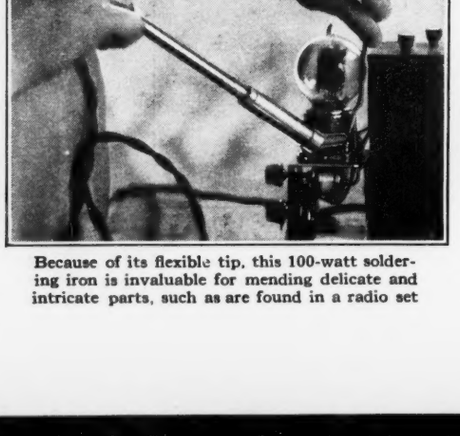
The next operation is to force the brad into the wood by pressure on the handle. The brad is held straight so that it cannot bend and the plunger pushes the head slightly below the surface of the wood so that sealing-wax can be applied if, for instance, the box contains an article of considerable value.

RECENTLY Dr. A. H. Lambert, of the Eastman Kodak Company's research laboratories, announced the discovery of a mysterious ingredient in gelatine that may make it possible to snapshot a bullet in flight or a flash of lightning. The discovery was made by Dr. S. E. Sheppard as the result of experiments extending over several years. The mysterious ingredient has proved itself valuable also in the transmission of pictures by radio.

"Electric Hand" Lays Bricks

ALMOST human in its motions is an electric gripper that stacks bricks on a truck ready for the kiln. This machine has rows of grippers, which in reality are electric fingers. The grippers are attached to the bottom of a segregator suspended from a crane. As the freshly made bricks travel from the brick-making machine, the rows of grippers pick up a brick in every "hand," and deposit them, spaced evenly, on the truck.

Novel Flexible Tipped Soldering Iron



Because of its flexible tip, this 100-watt soldering iron is invaluable for mending delicate and intricate parts, such as are found in a radio set

IN RADIO work especially, it often is difficult to reach the parts that are to be soldered, because the body of the iron strikes some other part in the set. The novel electric soldering iron shown at the left is said to overcome all difficulties along this line because the tip is arranged in a swivel joint so that it can be turned in any direction. It is rated at 100 watts and consequently is suitable for all kinds of work except in cases where a heavy duty iron is necessary.

Parking Tower for Autos Saves Ground Rent

A MOST ingenious parking tower for autos was invented recently by J. E. Morton of Purdue University, Ind.

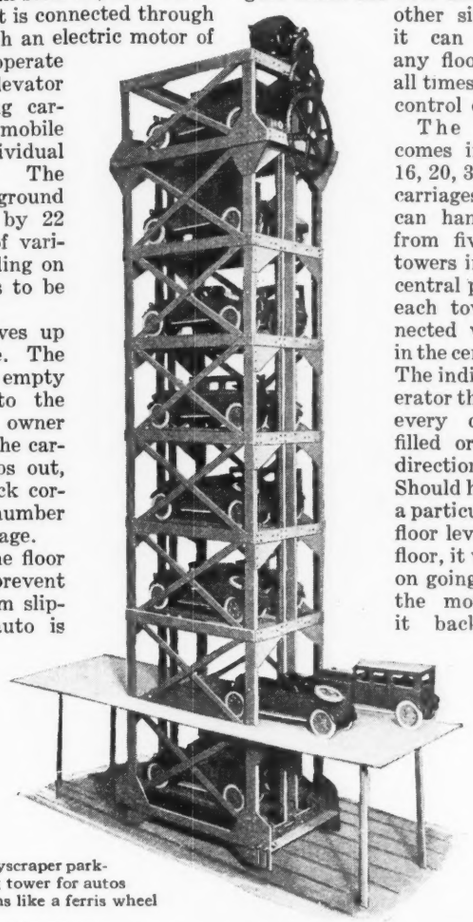
It consists of an all-steel tower in which a central drive shaft is connected through a train of gears with an electric motor of sufficient power to operate an endless-chain elevator of multiple parking carriages, each automobile having its own individual parking carriage. The tower covers a ground space of only 16 by 22 feet, though it is of variable height, depending on the number of cars to be parked.

A car-owner drives up to park his machine. The operator brings an empty parking carriage to the floor level, the owner drives his car into the carriage, locks it, steps out, and is given a check corresponding to the number of his parking carriage.

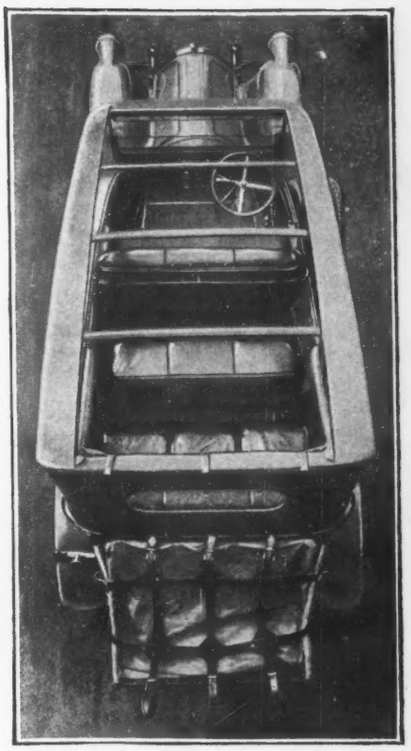
Guide rails on the floor of each carriage prevent the automobile from slipping; and each auto is protected also from drippings from the auto above it.

Merely by reversing the motor, the operator can bring a carriage to any floor level by the shortest possible route. The carriage at the top passes over and comes down on the opposite side, while at the bottom it goes under the floor and comes up on the other side of the tower; it can be stopped at any floor level and is at all times under the instant control of the operator.

The parking tower comes in several units—16, 20, 30, 40, and even 50 carriages. One operator can handle a battery of from five to 10 parking towers installed in a large central parking station, as each tower may be connected with an indicator in the central control room. The indicator tells the operator the exact location of every carriage, whether filled or empty, and the direction of its travel. Should he attempt to bring a particular carriage to the floor level, and it pass the floor, it would simply keep on going until he reversed the motor and brought it back to the right position. Nor could the owner enter it until it was safely stopped for him, when he could go in, unlock his machine, and back out into the street without delay.



Skyscraper parking tower for autos runs like a ferris wheel



Auto-Bus Has a Sliding Top

A SIGHTSEEING trip through the Big Tree district of California is spoiled if tourists cannot see the majestic height of the great trees.

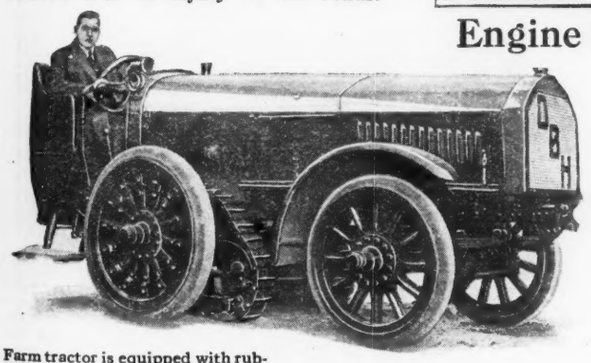
In order that no detail of the scenery be lost, a fleet of sightseeing cars operating in this part of the Yosemite is equipped with tops that can be rolled back. In case of a sudden shower the central section may be replaced quickly.

Hungers for New Inventions

I ALWAYS have had a leaning toward new inventions, and your magazine supplies exactly what I hunger for.—W. W., Reidsville, W. Va.

Tractor Uses Rubber-Tired Wheels for City Trips

FROM Germany comes the good-looking automobile shown below. It is intended primarily for use as a tractor on a farm, but with the addition of the rubber-tired wheels it can be used as an ordinary car and taken into the city, without fear of injury to the roads.



Farm tractor is equipped with rubber-tired wheels for city streets

Engine for Hauling Lumber Is Made of Junk

WHAT is probably the strangest homemade locomotive in the world is in use at a logging-camp in the woods of British Columbia, Canada. E. J. Byfield put together a few junked motor parts and produced an engine, which is mounted on a set of ordinary flanged traction wheels. A few yards of linked belting provided the necessary pulling power.

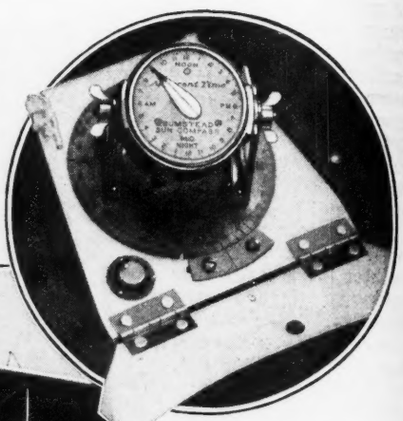
The locomotive runs on a specially constructed wooden track and loads of lumber are hauled in a trailer.

IT RECENTLY has been discovered by investigators into the subject that a plague of mosquitoes in certain localities is due to poor engineering practice in the construction of highways, railways, and reservoirs. Uneven surfaces, crevices in a loose joint and in walls provide hatching holes for the pests.

Latest Novelties in Aviation

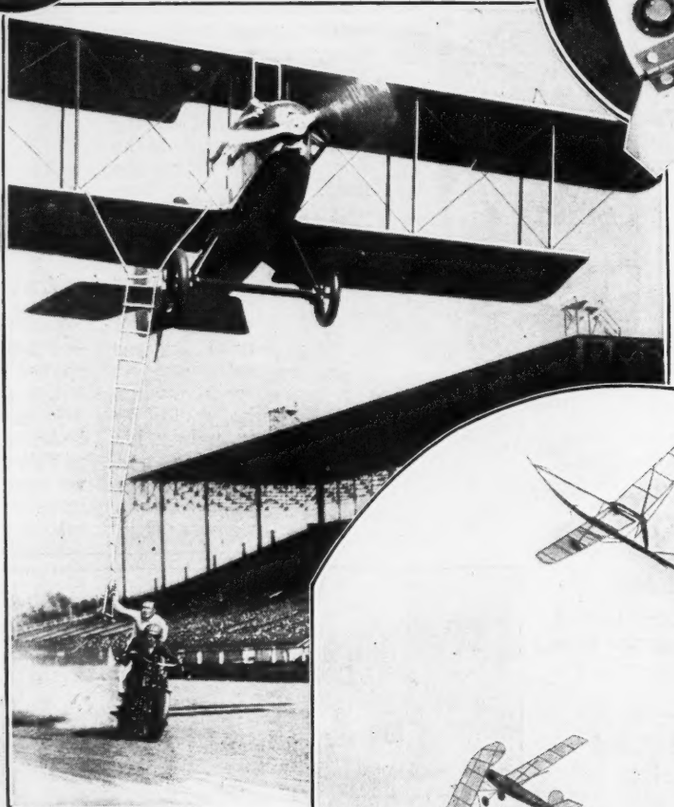
Balloon Targets

They look like toy balloons, but the big bubbles at the left really are targets used by army aviators at Crissy Field, San Francisco. As the balloons float in the air the fliers pepper them with bullets from machine-guns



New Sun Compass

Because of inaccuracies in magnetic compasses in the polar regions, each of the airplanes of the MacMillan Expedition this summer is equipped with this new instrument that gives directions accurately with the aid of the sun

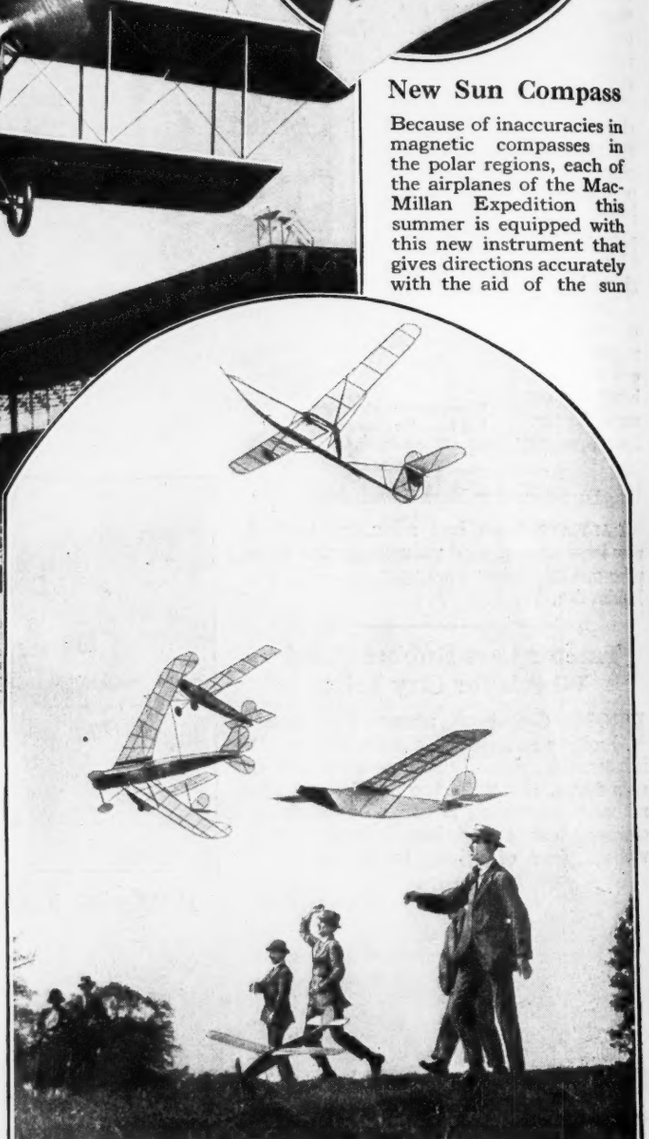


New Thriller

Racing 60 miles an hour on a motorcycle at St. Paul, Minn., Al Blackstone, daredevil acrobat, catches rope ladder dropped from plane, and climbs safely aboard

Ford Mast

Here is the great airship mooring-mast just completed at the Ford airport at Dearborn, Mich., as a harbor for the *Los Angeles* and other big dirigibles. It is 201 feet high, 26 feet higher than the navy mast at Lakehurst, N. J. A five-passenger elevator runs to the top

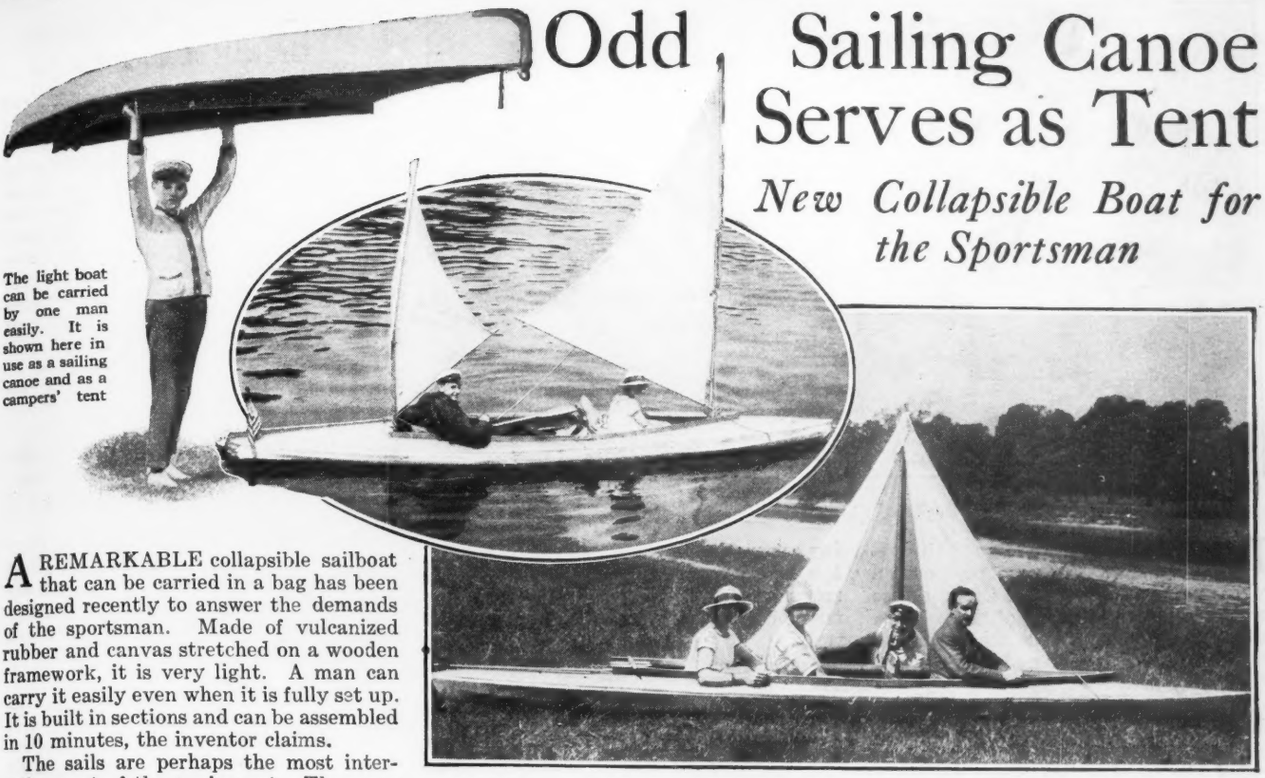


England Has Air Glider Races

Model gliders in recent cup races of the British Society of Model Aeronautical Engineers at Sudbury, England. An article in the July POPULAR SCIENCE MONTHLY described in detail how to build successful gliders of this type

Odd Sailing Canoe Serves as Tent

New Collapsible Boat for the Sportsman



The light boat can be carried by one man easily. It is shown here in use as a sailing canoe and as a campers' tent

A REMARKABLE collapsible sailboat that can be carried in a bag has been designed recently to answer the demands of the sportsman. Made of vulcanized rubber and canvas stretched on a wooden framework, it is very light. A man can carry it easily even when it is fully set up. It is built in sections and can be assembled in 10 minutes, the inventor claims.

The sails are perhaps the most interesting part of the equipment. There are two, one twice as large as the other. The mast for the larger one is stepped at the forward end of the cockpit, and the other fastened through the deck at the back of the cockpit.

When the sails are fastened to a ridge pole set up in the middle of the cockpit, they may be converted into a tent or boat cabin. Or if the camper prefers, he can set up the tent outside of the boat beside the stream, and use the boat as an ordinary canoe.

Comfortable seats with backs are provided. The combination canoe and sailboat will carry four persons, although, as in the case of any canoe, greater speed can be obtained when paddling if a lighter load is carried.

Ideal for the Embryo Mechanic

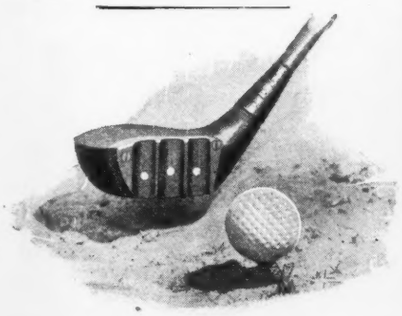
The word "Popular" is very significant, for at my home it is a contest between my three sons and myself to see who gets the first look. It is an ideal magazine for the embryo mechanic, to say nothing of the articles of a scientific nature that are most interesting to those who like to know.—Dr. B. C. W., Normal, Neb.

Stilts Are Carpenter's Stepladder

CLIMBING up and down a stepladder was not to the taste of the Paris carpenter shown at the right. He worked fast and was always having to move his ladder.

As a boy his favorite sport was walking on stilts. He still had a pair. He got them out and found them a splendid ladder substitute. The foot supports are adjustable to various heights.

Carpenter using stilts as a substitute for stepladder



Golf Club Prevents Slicing

AN AMATEUR golfer of Boston, John T. Manning, has invented a new club, a driver, which he claims cannot slice the ball. Vertical grooves fluted to correspond with the curvature of a golf ball are molded on the club's face. When the ball is struck, the ridges catch and drop it into one of the grooves, preventing motion sideways.

Stool Folds into Handbag

WHEN folded, this collapsible stool becomes a lady's handbag, as shown in the inset. It has a pocket on the outside for handkerchief and purse, and is fitted with a small mirror. After the stool is unfolded and before it is set up, the cushion on the seat is filled with air.

It is designed for use at picnics, in automobiles, on camping expeditions, or in crowded railway stations.

New Drawing Device Trains Student's Eye

TO TRAIN the eye of the art student in form, proportion, perspective, value, and color, Anson K. Cross, of the school of the Museum of Fine Arts, Boston, has invented a device the use of which introduces a new and easy method of studying art.

The device consists of a sheet of clear glass protected in a frame that holds a spirit level, and a white card that slides behind the glass. Two lenses slide between the lower members of the frame. These are used in painting.

The student draws on the glass with a special crayon. When the sketch is finished, he removes the opaque white card and views his drawing superimposed upon the model. The faults of the drawing are made clear. By constant use of the lenses to test sketches drawn from memory or observation, the student trains his eye to observe accurately and report form and color.

Occupant Serves as the Pole of Portable Bathing-Tent

A TREELESS bathing-beach offers no inconvenience to the bather who carries a portable bathing-tent of cretonne, a recent invention from London. It has the shape of a bag with a top section that fits on the bather's head like a hat. It envelops the whole body to permit a change of clothes, the bather himself supporting the tent.

Collapsible bathing-tent is made of rubberized cretonne

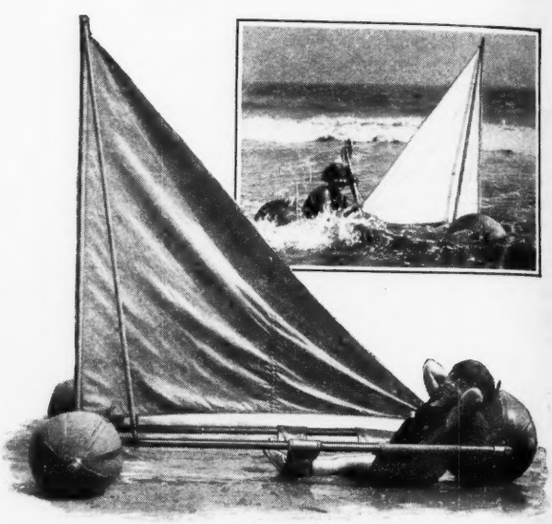
Discovers Moonlight Speeds Growth of Bacteria

GROWTH and activity of bacteria can be speeded up by the sort of light supplied by the moon, T. F. Morrison, graduate student at Princeton University, has discovered through experiments on the kind of micro-organisms that cause dead fish to shine in the dark. This work appears to confirm results obtained previously by E. G. Bryant, in South Africa, who found that fish exposed to moonlight spoiled more quickly than those kept in the dark.

Bottomless Sailboat Is Built for Use of Bathers

NO USE to bail water from the bottom of this sailboat! It cannot be done. It is intended for the use and pleasure of bathers.

A sail and three floats resembling huge basketballs make up the principal parts of the pleasure craft. Strips of canvas stretched between two horizontal poles serve as seat and support for the feet. A double-bladed paddle is provided.



A sail, three floats, and a canvas seat make an interesting toy for the seashore frequenter

Child's Chair Is Adaptable to Many Games

Wheelbarrow, train, or kiddy-kar can be made from this chair, the invention of two professors. A child's imagination must travel far to exhaust the chair's possibilities as a toy

WHEN children use ordinary chairs, which usually are favorite playthings, for trains, ladders, or beds, their fun often ends in grief. Household furniture is scratched and broken too easily.

Two university professors, F. W. Hart, of Berkeley, Calif., and Prof. Patty Smith Hill, of New York City, put their ideas together and invented a play chair that children cannot break, or, rather, one that can be broken easily without harming it. Children can take the chairs apart and make them into other playthings—carts, wheelbarrows, wagons, or trains.

THE number of motor-cars manufactured in the United States in a month is more than four times as great as the number of bathtubs shipped from factories during the same period, according to statistics from bathtub and motor manufacturers.

He Does *Two Things at a* Time and Does Them *Well*

One of the miner-cabinet-maker's masterpieces — a talking-machine cabinet that he built and whittled in the attractive design shown above. J. B. Shedd is a self-instructed cabinetmaker

On the table at the left are shown some other pieces from Mr. Shedd's jack-knife, the table itself being one of his prized achievements. Above he is holding one of his smaller pieces and demonstrating how he works with his jack-knife

NEAR Bessemer, Ala., there are coal-mines. On the night shift is a man who tends an electric pump in the very depths of the earth. This man is J. B. Shedd, and at one time he found the nights long and wearisome. Near by his pump was a number of empty dynamite boxes; in his hand a jack-knife. One suggested the other, and that was the beginning of J. B. Shedd's whittling activities.

At first he whittled only crude shapes from the boxes, but gradually, achieving a greater ease, his pieces of carving assumed a more finished shape. Then, instead of using merely one piece of wood, he made a box and decorated the sides and top of it.

One thing led to another and before Shedd realized it, he found himself to be a quite passable cabinetmaker with a knack at decorative whittling, and a reputation for making attractive bits of furniture.

No longer did Mr. Shedd find the nights too long in the coal-mine; sometimes they weren't long enough! Among the articles of furniture he has carved are tables, chairs, bookcases, and a talking-machine case.

Mr. Shedd says he never has had a lesson in cabinetwork or whittling. He still remains at his job tending the electric pump, and he has discredited the old proverb that it is possible to do only one thing at a time and do it well.

A Vacuum Chimney-Sweep Cleans Furnace Flues

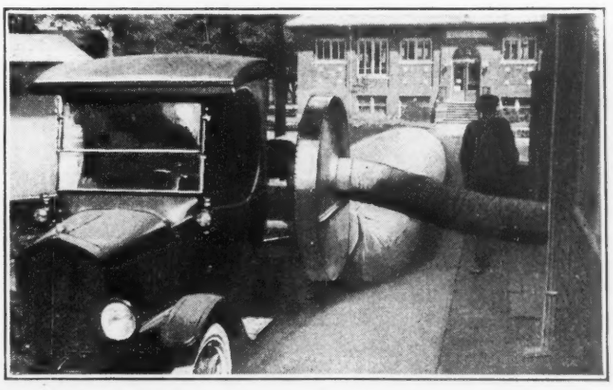
FOURTEEN years in the furnace business gave Titus Russell, of Albion, Mich., a thorough knowledge of furnace operation. The accumulation of dust and carbon deposits, or soot, in the furnace radiating channels has always been one of the greatest fire menaces, and it was in this subject that Mr. Russell interested himself.

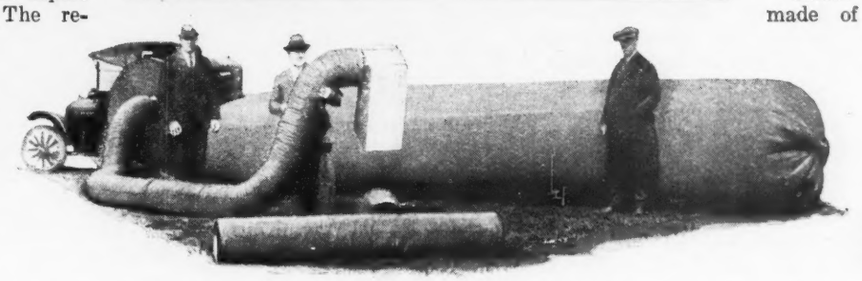
Eleven years ago he began thinking of a method of reversing the air draft through the furnace pipes, and a cleaning system based upon expert heating principles. The result has been a machine that is said to clean furnace pipes thoroughly.

A 22-horsepower engine is mounted on a truck. An iron shaft extending from the crankshaft of the motor carries flywheel and fan. The intake is at right angles to the hub and draws through a series of tube sections that can be placed through any cellar window to the furnace. The outlet is at the rear base of the outer case, releasing into a huge sack.

A mouthpiece, attachable to any needed length of tube, is so constructed that it will fit any furnace door with an airtight grip. With this apparatus the work of a chimney-sweep is done at one sweep, and the entire furnace cleared of soot.

Other uses have been made of this furnace-flue cleaner. For instance, the end of the tube was put in a load of gravel, the motor started, and the gravel moved in a steady stream through the machine to a neat pile 40 feet away, all in less time than two men could remove the load.





Above: Flue-cleaner truck drawn up beside a residence, showing the great dust bag, flywheel, and tube. Below: Man holding the mouthpiece of the flue-cleaner that is adjustable to give an airtight fit to the door of any furnace. A 22-horsepower motor on the truck runs the flue-cleaner

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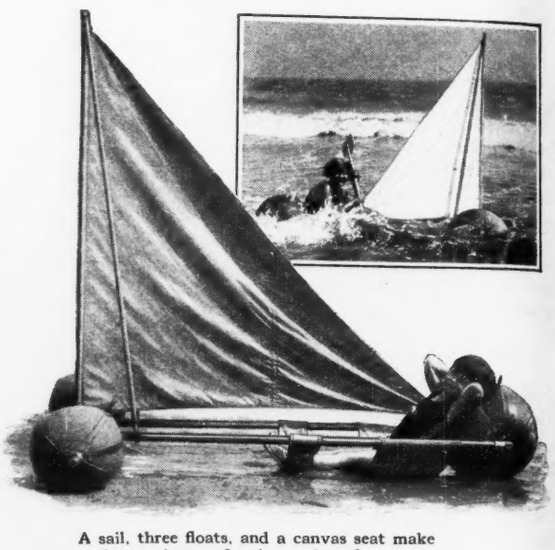
NO USE to bail water from the bottom of this sailboat! It cannot be done. It is intended for the use and pleasure of bathers.

A sail and three floats resembling huge basketballs make up the principal parts of the pleasure craft. Strips of canvas stretched between two horizontal poles serve as seat and support for the feet. A double-bladed paddle is provided.



A sail, three floats, and a canvas seat make an interesting toy for the seashore frequenter

Child's Chair Is Adaptable to Many Games

Wheelbarrow, train, or kiddy-kar can be made from this chair, the invention of two professors. A child's imagination must travel far to exhaust the chair's possibilities as a toy

WHEN children use ordinary chairs, which usually are favorite playthings, for trains, ladders, or beds, their fun often ends in grief. Household furniture is scratched and broken too easily.

Two university professors, F. W. Hart, of Berkeley, Calif., and Prof. Patty Smith Hill, of New York City, put their ideas together and invented a play chair that children cannot break, or, rather, one that can be broken easily without harming it. Children can take the chairs apart and make them into other playthings—carts, wheelbarrows, wagons, or trains.

THE number of motor-cars manufactured in the United States in a month is more than four times as great as the number of bathtubs shipped from factories during the same period, according to statistics from bathtub and motor manufacturers.

He Does *Two Things at a* Time and Does Them *Well*

One of the miner-cabinet-maker's masterpieces — a talking-machine cabinet that he built and whittled in the attractive design shown above. J. B. Shedd is a self-instructed cabinetmaker

On the table at the left are shown some other pieces from Mr. Shedd's jack-knife, the table itself being one of his prized achievements. Above he is holding one of his smaller pieces and demonstrating how he works with his jack-knife

NEAR Bessemer, Ala., there are coal-mines. On the night shift is a man who tends an electric pump in the very depths of the earth. This man is J. B. Shedd, and at one time he found the nights long and wearisome. Near by his pump was a number of empty dynamite boxes; in his hand a jack-knife. One suggested the other, and that was the beginning of J. B. Shedd's whittling activities.

At first he whittled only crude shapes from the boxes, but gradually, achieving a greater ease, his pieces of carving assumed a more finished shape. Then, instead of using merely one piece of wood, he made a box and decorated the sides and top of it.

One thing led to another and before Shedd realized it, he found himself to be a quite passable cabinetmaker with a knack at decorative whittling, and a reputation for making attractive bits of furniture.

No longer did Mr. Shedd find the nights too long in the coal-mine; sometimes they weren't long enough! Among the articles of furniture he has carved are tables, chairs, bookcases, and a talking-machine case.

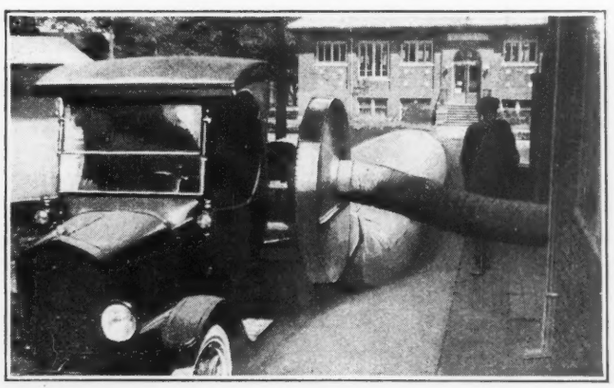
Mr. Shedd says he never has had a lesson in cabinetwork or whittling. He still remains at his job tending the electric pump, and he has discredited the old proverb that it is possible to do only one thing at a time and do it well.

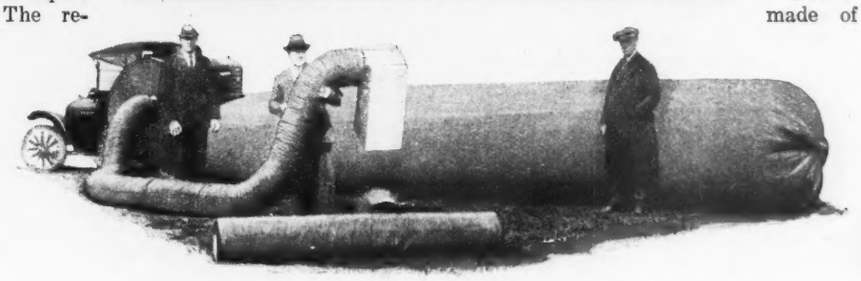
A Vacuum Chimney-Sweep Cleans Furnace Flues

FOURTEEN years in the furnace business gave Titus Russell, of Albion, Mich., a thorough knowledge of furnace operation. The accumulation of dust and carbon deposits, or soot, in the furnace radiating channels has always been one of the greatest fire menaces, and it was in this subject that Mr. Russell interested himself.

Eleven years ago he began thinking of a method of reversing the air draft through the furnace pipes, and a cleaning system based upon expert heating principles. The result has been a machine that is said to clean furnace pipes thoroughly.

A 22-horsepower engine is mounted on a truck. An iron shaft extending from the crankshaft of the motor carries flywheel and fan. The intake is at right angles to the hub and draws through a series of tube sections that can be placed through any cellar window to the furnace. The outlet is at the rear base of the outer case, releasing into a huge sack.





Above: Flue-cleaner truck drawn up beside a residence, showing the great dust bag, flywheel, and tube. Below: Man holding the mouthpiece of the flue-cleaner that is adjustable to give an airtight fit to the door of any furnace. A 22-horsepower motor on the truck runs the flue-cleaner

A mouthpiece, attachable to any needed length of tube, is so constructed that it will fit any furnace door with an airtight grip. With this apparatus the work of a chimney-sweep is done at one sweep, and the entire furnace cleared of soot.

Other uses have been made of this furnace-flue cleaner. For instance, the end of the tube was put in a load of gravel, the motor started, and the gravel moved in a steady stream through the machine to a neat pile 40 feet away, all in less time than two men could remove the load.

Handy Utilities *for* Town,

Dustproof Hood Devised for Furnace Cleaners

FOR use in cleaning boilers, furnaces, and tanks, a new type of protection against dust, a hood of finely woven canvas that fits snugly over the head and shoulders and is held tightly to the body by elastic bands at the wrists and waist, recently has been invented by Tim Leonard, foreman of boiler cleaners for the United Electric Light and Power Company, New York City.

In the mask are extra large lenses that are non-fogging so that the worker can see plainly through dust as he cleans a boiler. The ordinary aluminum sponge respirator, with pneumatic cushion and outlet valve, is fixed inside the head piece. Fireproof material can be used for the hood.

The safety device has been declared highly satisfactory by experts and is said to be a great improvement over other protective masks for this purpose.

"Mystery Lamp" Lights when You Pick It Up

A "LAMP OF MYSTERY," so called because it lights when you pick it up and goes out when you put it down, has just been devised as an electrical improvement on the old-time household candle.

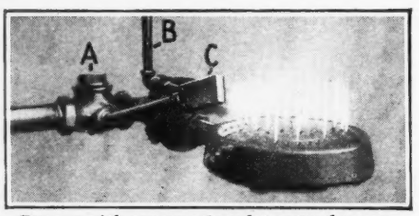
Ornamental flashlight lamp and the battery that lights it

The secret of its operation lies in an electric dry battery concealed in the base, and an ingenious method of making and breaking electrical contacts by means of a weight arrangement actuated by the lifting or setting down of the lamp.

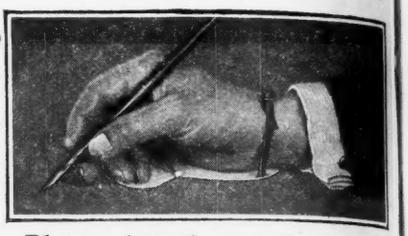
Automatic Safety Device Shuts Off the Gas

TO PREVENT explosions or asphyxiation from escaping gas in gas boilers or furnaces a device has been perfected that shuts off the supply of fuel when the pilot light is extinguished. It consists of a small box, *C*, containing a thermocouple, which is heated by the pilot light supplied by pipe *B*. When heated, this metal expands so that it opens the check valve *A*, permitting gas to flow from the main pipe to the burner.

Should the light go out for any reason, the metal contracts and the ball in the check valve falls again into its seat, closing the supply of gas to the main burner. The gas flow can be resumed only by relighting the pilot light. This can be done electrically from a distance simply by pressing a switch button that may be located in the most convenient place.



Burner with automatic safety attachment



Blotter Attachment for Hand Is a New Aid for Writers

ONE who has to do much writing with pen and ink will find this hand blotter useful. It is held in position by elastic bands that slip over the wrist and around the little finger. Besides blotting, it provides a shield to protect paper from perspiring or soiled hands. It also protects the hand when stamping and sealing letters or when using paste or glue.

The Hardest Metal Surface

A NEW process for electroplating metals with an alloy composed chiefly of chromium, the hardest substance in existence next to diamonds, recently was announced by Dr. Colin G. Fink, professor of electrochemistry at Columbia University. The surface produced by this process is said to be harder than any other known metal surface.

Small Movie Machine Designed for Amateurs

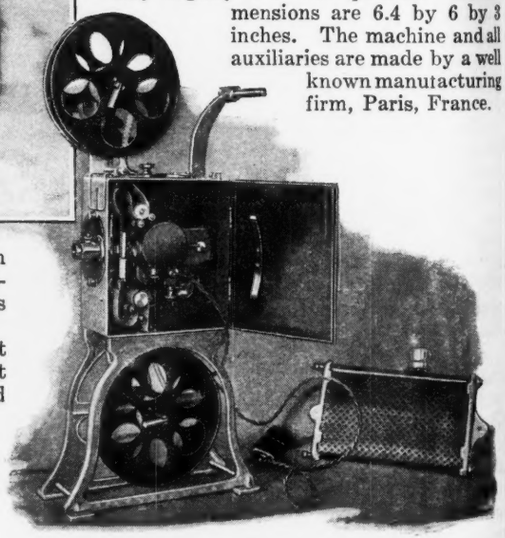
A NEW motion-picture camera that both takes and projects motion pictures, made especially for the amateur, recently was perfected in France. The machine takes films of just half the ordinary width, so that regular motion-picture films cut in half lengthwise can be used. A circular cutter especially devised for cutting film is part of the equipment.

The machine takes a film about 790 feet long, which is equivalent to about 2000 feet of standard film. Each "frame" or image measures about one-third by one-half inch.

The same machine that is used for taking the views is used in projecting them as shown in the picture below. The inside reels are replaced by a circular case holding the projector light; and the machine is placed on a stand that holds two large metal reels. There are two lenses, as shown in the left-hand photograph, one for taking the pictures and the other for projection.

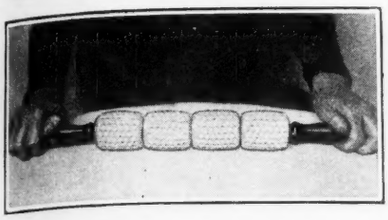
For long scenes, the machine is placed on a tripod to hold it steady; but for short reels of from 100 to 150 views, the machine can be held in the hand, and in that case an auxiliary motor is used to turn the reels.

It is housed in a metal case, and weighs only slightly over four pounds. Its dimensions are 6.4 by 6 by 3 inches. The machine and all auxiliaries are made by a well known manufacturing firm, Paris, France.



The new apparatus used as camera (above) and projector

Country, *and the* Home



Rolling-Pin Massage for Weight Reduction

ROLLING oneself out with a rolling-pin to get rid of excessive avoirdupois may not appeal to one who wishes to lose weight, but if the rolling is done with the massaging device illustrated above, the process, it is said, need not be painful.

The four sections of the roller, fitted with vacuum cups, revolve over the body under very light pressure, producing the beneficial results from massage. This action is said to stimulate blood circulation and to break down fatty tissue, keeping the flesh in firm condition.

$66,000,000 Paid for Air Holes

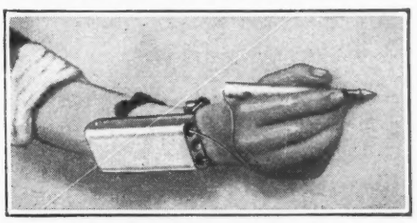
HE WHO buys ice-cream by the bulk instead of by weight, pays dearly for the air holes in the confection, according to facts revealed at the recent conference on weights and measures at the Department of Commerce.

A billion quarts of ice-cream are made by dealers in this country annually, it was found, but a fifth of the total amount sold is air space that is "packed" into the containers in which the ice-cream is sold. Selling the ice-cream by bulk instead of by weight, it is estimated, means that somebody pays $66,000,000 for the air holes.

Wrist Case Invented for Pencils and Pens

THE man who keeps his pen and pencils in a newly devised wrist case has them always at hand, the inventor says, and yet out of the way when not in use. The case fastens on the arm with two straps.

The pencils are attached to the case with small chains wound on spring reels that hold them in their compartments when not in use. Turning a lever at the top of the case projects a pencil from the holder so that it can be grasped. As it is pulled out, the chain with which it is attached unwinds from the reel. When the pencil is drawn back by the spring reel, it is locked automatically in its compartment. Three compartments are provided for the convenience of the wearer.



How case is strapped to wrist

Father Time Races Stork

DURING 1924, 2,645,000 babies were born and 1,333,000 persons died in the United States, or one death was compensated for by two births. If the number of births and deaths remains the same in 1925, as this rate seems to indicate, 10 babies will be born every two minutes and five persons will die in the same time.

Aluminum Honeycomb to Double Bees' Output

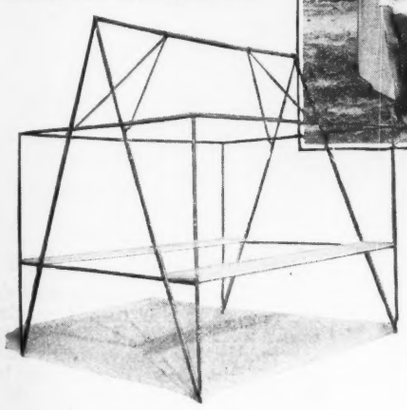
FOOLING bees with a new type of honeycomb made of aluminum is said to add greatly to profits of bee-keepers. By lessening the time needed to manufacture comb, it is said to enable the bees to double their output of honey.

The aluminum combs are painted with beeswax in its pure state and the bees go right ahead and fill them just as if the combs were a homemade article. When filled, the combs are put in a machine called a "honey extractor," which whirls the combs around and extracts the honey by centrifugal force. The combs then can be returned to the hive for the further manufacture of honey.

Metal Frame Supports New Concession Tent

AN INNOVATION in the construction of concession tents is embodied in the model pictured here. The framework is made of seamless brass and aluminum tubing, with joints of brass, which make for lightness and strength. The frame stretches the canvas, making it water-tight, and taking the strain off the guy ropes. So simple is the construction, that with but little practice the tent can be put up in 15 minutes.

The completed tent, with awnings



Metal frame ready for the canvas

The entire framework is collapsible, and when unfolded is held rigid by cross braces fastened with bolts. Two metal counters, one on each side, are set in the frame.

For severe weather four guys are used, and steel pins are driven through holes at each corner of the frame.

Button Operates Keyless Automatic Lock

A KEYLESS, automatic button lock recently devised for house doors may be installed in 10 minutes, it is claimed, using only two screws. Merely pressing a button in the center of the knob locks the door, while turning the knob automatically unlocks it. A glance at the position of the button shows whether the door is locked or unlocked.

Knobs may be had in either glass or metal. This type of lock is especially useful for the bathroom where the door must be locked frequently. A key is used only on the outside of an outside door, and here the keyhole is placed in the center of the knob, where it is easily found in the dark.

The button lock is a compression-spring, unit-type lock, which automatically adjusts itself to the thickness of door as it is being installed. The inner knob is detachable; but not the outer knob.

Pressing a button locks the door

New Ideas for the

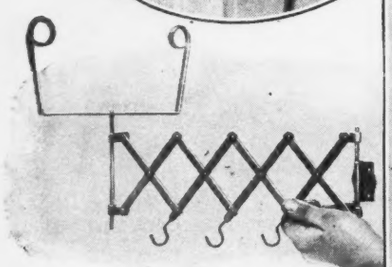
Combination Range and Cabinet

Bristle Filler for Brooms

You need waste very little of your broom bristles now that a new filler can be fitted into the handle of a broom when the old one wears out. A spring gives the broom flexibility so that the fiber bristles can be worn down to an inch before discarding

To Remove Cap Jars

Now that canning days are here, good housewives are looking for the most efficient utensils. Above is shown a new jar-top remover, said by the inventor to be "different." A self-adjusting link grips and securely holds any size jar cap. It is very easy to handle and works quickly



Hat-Hanger Fits on Clothes-Rack

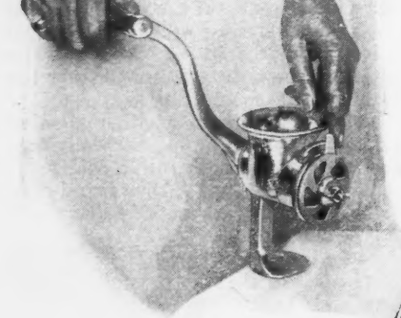
POPULAR SCIENCE MONTHLY has pictured in an earlier issue a collapsible clothes-hanger, such as shown above, but without the hat-holder, which the inventor has added for use in small closets, where often no provision is made for hats. When extended, the hanger has four substantial hooks for clothes. When it is not in use, it occupies very little space

Range and Cabinet in One

Thoroughly insulated, the makers claim, so that no hot air can spoil the edibles, this combined kitchen range and cabinet is a boon to housewives, saving many steps. The cabinet forms a support for the range, and has spaces for pots and pans and kitchen cutlery, as well as drawers for spices, flour, and sugar

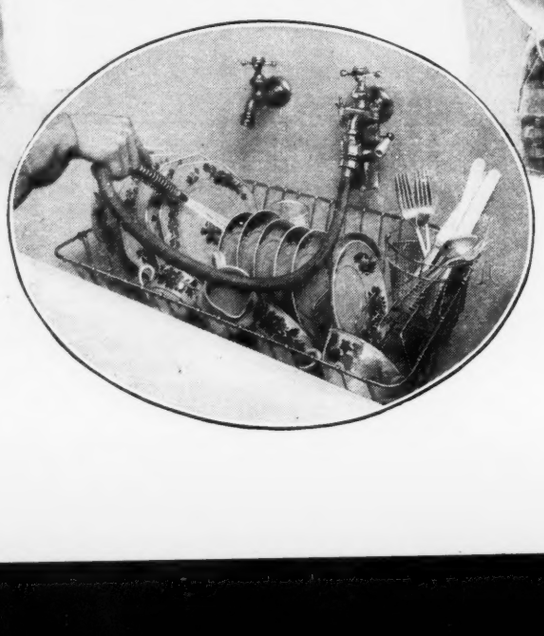
Food Grater Has a Glass Top

Said by its makers to be able to grate any kind of food, the little grater below is distinguished from other graters by its glass top, which is used for the purpose of pushing down the food and thus saves fingers from being caught



Improved Meat-Grinder

With a mere shift of a lever on this improved meat-grinder, the degree of grinding from fine to coarse, or contrariwise, is changed. This little attachment makes it unnecessary to remove one cutting disk and insert another, as it has heretofore been necessary to do



Dishwashing Made Easy

Dirty dishes are placed in the sink rack. The hose is turned on, the soap lever pressed, dishes are sprayed with hot soapy water, then with clear water. Dishes remain in the wire rack until thoroughly dry, or remain until the next meal is set

Up-to-Date Kitchen

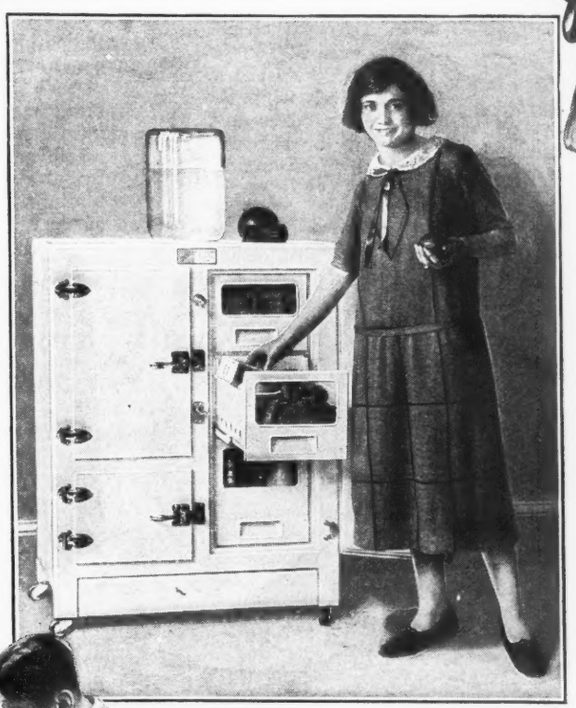
Saves the Housewife Many Steps

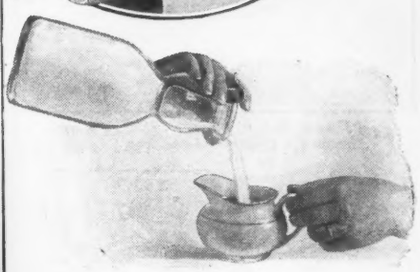
Wooden Pot-Scraper

This scraper is for use on aluminum and glass utensils, as any kind of metal scraper is bad for them. The scraper has the advantage, too, of not setting the housewife's teeth on edge by contact of grating metal on metal

Safety Window-Cleaner

As shown in the picture at the right, a square cleaning pad is placed at the end of a bent rod. The operator stands on the inside of the window and passes the cleaner back and forth until the window is spotless



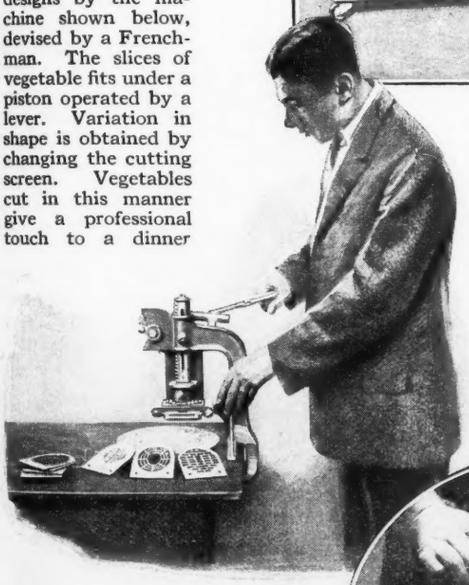


Milk-Bottle Separator

There is now on the market a new kind of milk-bottle that keeps the cream separate from the milk, although, if required, the cream and the milk can be mixed by the simple means of turning the bottle upside down. It is claimed that by using the separator and pouring off the cream, a whipping cream is obtained or cream suitable for the morning coffee or for your favorite cereal

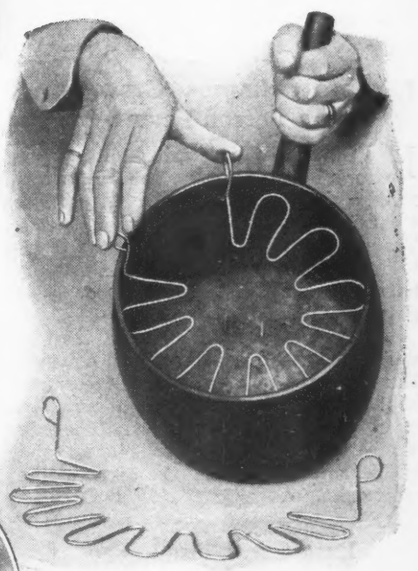
Seven-Design Vegetable Cutter

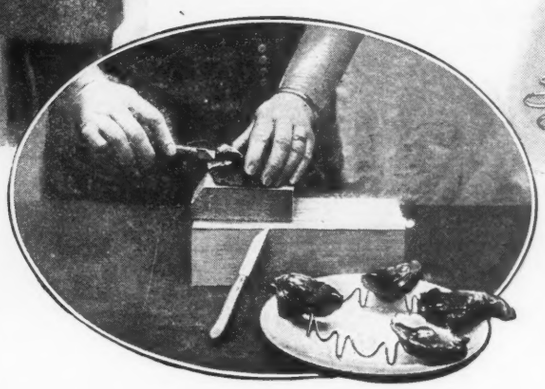
Vegetables may be cut in seven different designs by the machine shown below, devised by a Frenchman. The slices of vegetable fits under a piston operated by a lever. Variation in shape is obtained by changing the cutting screen. Vegetables cut in this manner give a professional touch to a dinner



Icebox like Filing Cabinet

Instead of shelves this refrigerator has closed compartments that slide in and out. This construction serves several purposes, the most important of which is that as the needed drawer is pulled out, it automatically closes the box, thus maintaining an even temperature at all times, besides being an advance over having to stoop to see what supplies every shelf contains





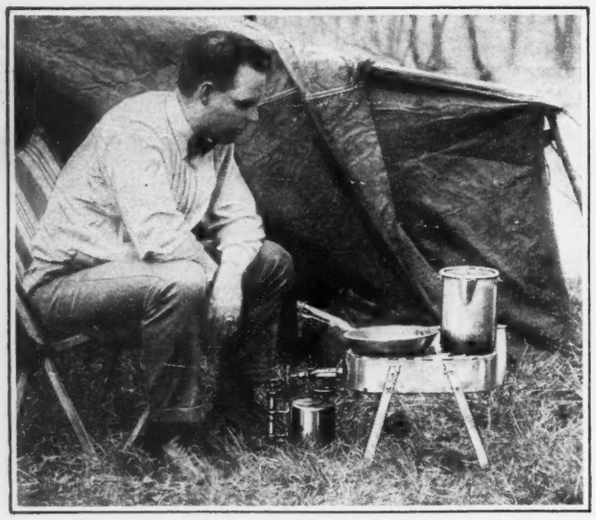
Oyster-Opening Set

At right is an oyster-opening set from France. The oyster shell is placed in a cavity in the block of wood and pried open by a clawed knife, used also for detaching the oyster from its shell. The oyster then is placed in the wire rack

Water Will Not Boil Over

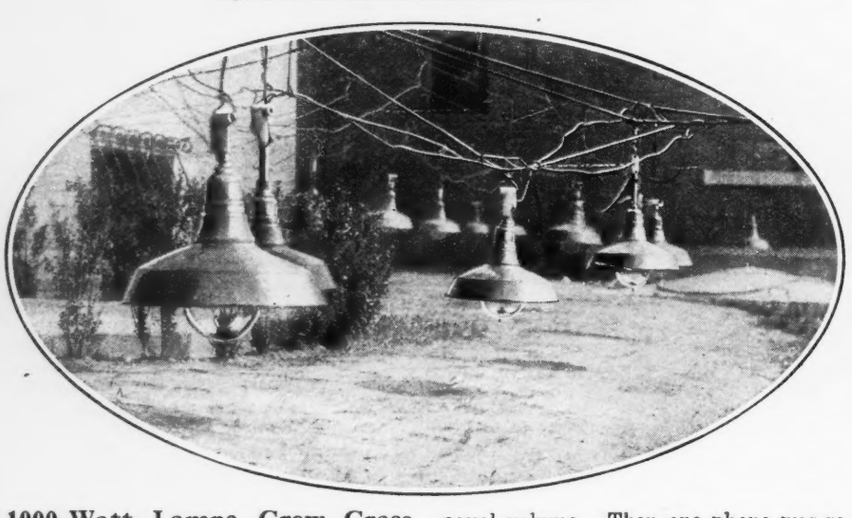
Water will boil up and over very quickly when cooking greens. It is claimed by the inventor that by the use of the ring shown above, the greens are held down, giving more room for the water to flow and bubble, and thus preventing boiling over and saving constant watching

Simple Camp Stove Is Heated by Blowtorch



Heated by a blowtorch, this simple little stove has room for frying and cooking, folding up when not in use

ANY make of blowtorch may be used to provide heat for this compact collapsible camp stove. Most persons have such a torch about the house or can borrow one for the week-end. The stove is simple in construction and weighs only 6½ pounds. It has two burners and is 10 inches high. The supports, which fold up around each end of the stove when not in use, set firmly on the ground and hold the stove securely while the camper's coffee and bacon for breakfast are cooking just outside the flap of the tent.



1000-Watt Lamps Grow Grass on Barren Lawn

IF POWERFUL electric lights strung over a barren lawn can force grass into rapid growth, why should not similar treatment make hair grow on a bald head? Tests with 1000-watt lamps at the Cambridge, Mass., Electric Light Company have shown astonishing results on grass growth.

Dr. Andreas F. Christian, of Boston, claims that bald heads may be covered, beards coaxed on clean-shaven faces, and bobbed hair grown long in a short time, by use of strong artificial light. The only requisite in cases of both lawns and heads, he says, is that the germ of life must exist.

Ears Grow Tired, Too

THE ear apparently becomes physically tired, asserts Prof. Albert Sidney Langfeld, director of the laboratory of experimental psychology at Princeton University.

By means of radio apparatus, Professor Langfeld led the sound from oscillating vacuum tubes to head phones that were adjusted until the wearer declared the sounds reached each ear with absolutely equal volume. Then one phone was removed, and the hearer required to listen with one ear for a minute. At the end of that time both phones were used again, and invariably the subject reported hearing the sounds more loudly in the ear to which the phone had just been added.

Ceiling Insert of Steel for Concrete Buildings

BELOW is shown a recently designed steel insert that is fitted in the molds of concrete ceilings, so that when the concrete is flowed into the molds, the insert becomes firmly embedded as the mixture dries. Thus there is established a socket that will sustain pipes or other fixtures. A threaded unit is inserted sideways through the narrow passage into the hollow square, where it is straightened out and the fixture screwed into it.

How steel insert sets in a ceiling

Photographic Plates May Be Developed in Daylight

AFTER research extending over a period of several years, Dr. H. Leffman, a chemist of Philadelphia, discovered that the process of developing and fixing a photograph negative in the daylight, when it can be more carefully watched and controlled, is a decided advantage over the prevailing method of darkroom development.

If the exposed plate is first placed in the hyposulphite of sodium solution, it will dissolve and remove only the particles of silver bromide that have not been acted on by light. When the fixed plate is removed from the hypo solution, it is perfectly transparent, without a trace of indication that it has been exposed in the camera. Yet it bears in latent form the picture photographed. The fixed plate or film may be exposed to daylight without injurious effect on the latent picture, which can be developed in broad daylight by submerging the photographic plate or film in a solution of chloride or bromide of mercury.

Oxygen-Generating Mask for Miners and Divers

A GAS mask that produces its own oxygen has been invented recently by H. C. Carter of Victoria, Australia. Renewing gas in masks has been for a long time a leading problem in making oxygen masks that are used by miners and divers.

Collapsible Hand-Cart Takes Little Space for Storage

ONE of the greatest problems offered to the owners of hand-carts is the amount of space they take up when stored away for the night. This new German invention seeks to overcome this difficulty. The bottom of the cart divides at the center line and the halves fold up against the sides. Then the user pulls a lever, which bends the axle and the bottom frame members, which are hinged at the center, and the entire hand-cart can be pushed into a space less than two feet wide.

The picture illustrates the hand-cart in the process of being folded.

This hand-cart folds into space less than two feet wide when work is done

New York Builds the Largest Power-Generating Station

THE largest electric generating station in the world is being erected on the East River in New York City. It will have a capacity of 1,000,000 horsepower, enough to light at least 3,000,000 six-room houses. Operated at full capacity this single station would be capable of providing all of the electricity required by any state in the United States, New York excepted.

It will be capable of producing 100,000 more kilowatts than the projected power development at Muscle Shoals. Imagine all of the horses in all of the cities in the United States, 2,000,000 of them, hitched to one load. Their power would just equal that of the great aggregation of power available in New York City when the new $50,000,000 plant is completed.

Water from the river will be used in the station and coal will be unloaded directly into bunkers from ocean-going vessels by means of traveling towers along the waterfront.

LOUD chewing is the undoing of certain insects and grubs traveling from the Orient to the United States in sacks of peanuts. A newly invented microphone intensifies the sound of their champing and enables customs officials to detect their presence. The apparatus is used, also, in finding insect pests in stored grain and fruits.

Unsinkable Rowboat May Be Folded into Compact Bundle

HERE is the latest idea in folding boats. It can be rowed or paddled like a canoe and is sufficiently large so that the passengers are not cramped. The flat bottom makes the boat steady. Packed into a bundle as shown at the right, it weighs but 36 pounds.

Airtight chambers are arranged along both sides, so that the boat is unsinkable, even when it is full of water.

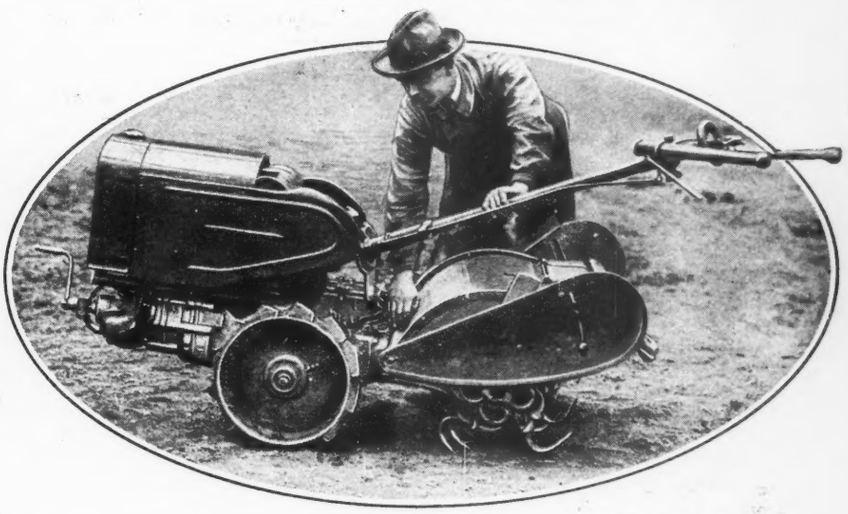
Airtight chambers set along each side of this collapsible rowboat render it unsinkable

Small Pump Converts Auto into Fire-Engine

THOUGH small in size, this portable pump, which can be attached to an automobile in two minutes, will do a good day's work, raising 100 gallons of water a minute by suction alone to the pump's level and then spraying it a height of from 50 to 60 feet.

The pump is operated by means of a belt around the rear wheel of an auto after the wheel has been jacked up. It is especially recommended for small towns that have no regular fire-fighting equipment or those in the neighborhood of large forests. It also is useful for pumping out cellars and ditches after an accident or a flood has caused an overflow of water that will not drain off quickly.

Hitched by pulley to the hind wheel of an auto, this small pump is said to raise 100 gallons of water a minute



New Gasoline Tiller Replaces Old "Dobbin"

THIS remarkable invention consists of a one-cylinder gasoline engine built into a compact one-man machine arranged to do tilling and ridging in one operation.

It is claimed that this compact little machine will prepare two acres of land in an ordinary farm day. One of its most important features is that it is so small it can be used under overhanging branches and between growing bushes where no ordinary type of plow could be used, and this is especially useful in orchards where land between the trees is utilized for growing vegetables.

An Amazing New Auto

FROM Poland recently came word of an astonishing sort of automobile. It is the invention of an engineer named Kerpowski, and he calls it the "Polonia," after his native land. It is designed to bring about the utmost simplicity and speed in making repairs and replacements of parts.

In a recent public test, two mechanics and a helper took down the motor, gear set, universal, and rear axle in 14 minutes, and had the car completely reassembled in 36 minutes additional. The car has a six-cylinder motor, develops 45 horsepower and is said to be capable of a speed of more than a mile a minute.

Mouse- or Rat-Trap Is Set by Pressure of the Foot

NO ONE wants to set a mouse-trap. The little wire is fixed just right, when "Snap!"—once again your fingers are caught.

In the illustration at right is shown a new safety mouse- and rat-trap, which is set with pressure of the foot. After a rodent is caught and killed, a slight pressure on the foot plate will release it. The trap is made of galvanized steel and wire.

Pressure of foot will set this novel mouse-trap

For Farm and Garden

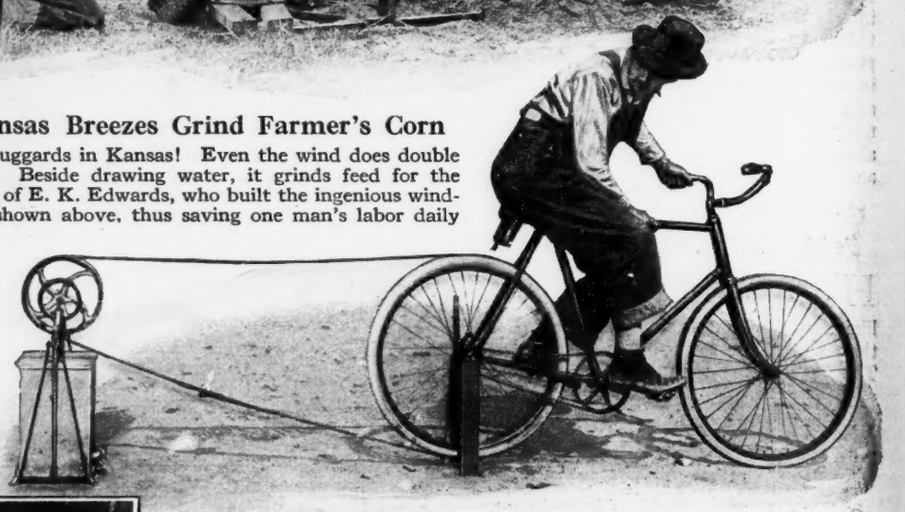
Some Ingenious Outdoor Ideas That Will Be Found Useful

Handy Grass Trimmer

Operating like a barber's clipper, the handy little grass-trimmer shown above is designed to cut the uneven edges of lawns and to penetrate corners no ordinary lawnmower could negotiate

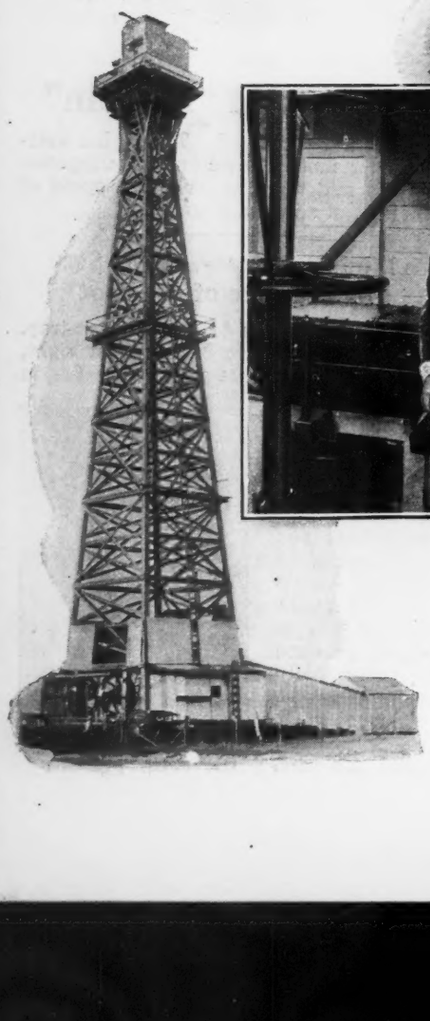
Kansas Breezes Grind Farmer's Corn

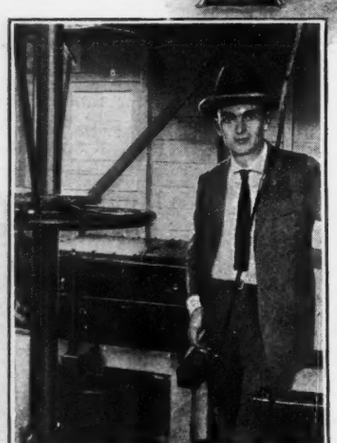
No sluggards in Kansas! Even the wind does double duty. Beside drawing water, it grinds feed for the stock of E. K. Edwards, who built the ingenious windmill shown above, thus saving one man's labor daily



Butter Churned by Bicycle-Power

This ingenious apparatus for churning butter was rigged up by a Minnesota farmer. Raising the rear of his bicycle on wooden stilts, he ran a belt from the rear wheel to the wheel drive of the odd churn





"Rain-Making" Tower

William Haight, of Wilmington Park, Calif., claims he can make rain by the manipulation of what he calls negative electric ground waves and positive waves of the atmosphere's upper strata. His apparatus, mounted on a tower (at extreme left), is designed, he says, to reverse the natural order of electrical emanations, resulting in a pulsating current between the ground and upper strata, which in turn causes condensation of cloud moisture and brings on rain. Mr. Haight is pictured at the left

For Rough Mowing

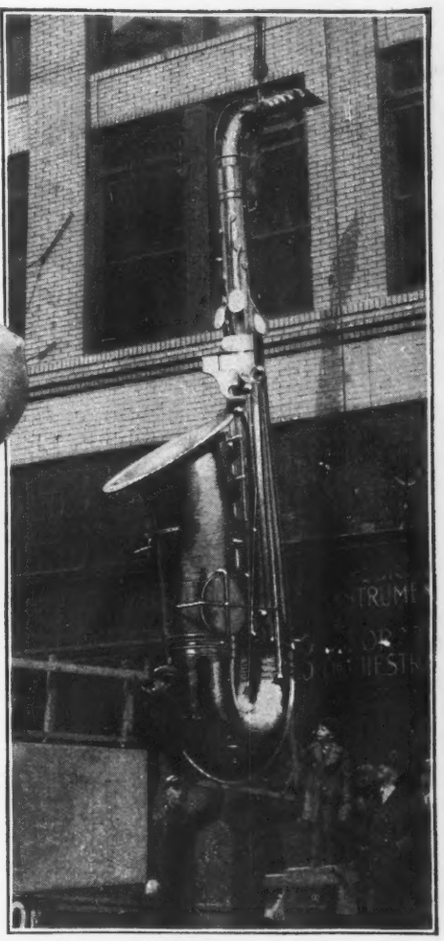
At the right is a new mowing machine designed to "top" tall growth or to clean up a lawn after a lawnmower. It is not intended to replace the lawnmower. It is said to cut 10 times as fast as a scythe

They Don't Come *Any* Bigger

These Oddities Claim the World's Records for Size

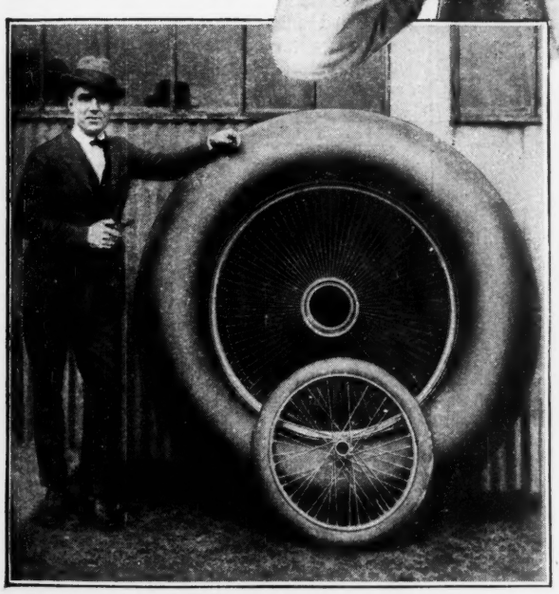
A 22-Foot Saxophone

Wanted—a musician with lung power enough to play the world's largest saxophone that forms part of an advertising display for a New York musical-instrument concern. This giant jazz creator is 22 feet high and its bell is four feet in diameter. Workmen are seen hoisting it into place



Padlock for Park

This immense golden padlock and key were used in the recent celebration officially opening the Zion National Park, in Utah



Have a Match?

Have you ever seen larger matches than these? Dixie Boatwright, popular Ziegfeld Follies girl, who is seen carrying a box of them on one shoulder like a bundle of kindling wood, says you don't strike them any bigger hereabout

Supports 10 Tons

The largest pneumatic tire ever made in America—64 by 14 inches—was designed for the landing gear of one of Uncle Sam's largest planes. It will carry 20,000 pounds

A Long Smoke

A briar pipe 5½ feet long is Lady Nicotine's latest curiosity. It requires the services of a smoker and two assistants to get it really going

Puzzle—Find the Man

Barney Winters, of New York, boasts of a hat that would fit a giant—all straw and a yard wide at the brim

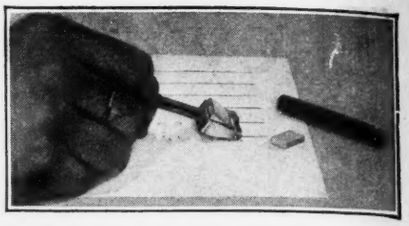
Carry Your Own Hot-Lunch Kit

By the use of heater-lunch-box, food is served appetizingly

A UNIQUE little "traveling restaurant," invented in France, enables you to have piping hot food instead of cold lunches at work or on picnics. It is a portable box about the size of a brief-case, easily carried on hikes or in motor-cars.

In one section are oblong plates supported in a frame raised slightly above the side of the case. Small gasoline or alcohol cube lamps under these heat the food at lunch-time. Leakproof metal lids fit over the compartments.

A plate, knife, and fork are held in the other side of the valise and a thermos bottle and drinking-cup are placed in special racks. The open box forms a small table as it rests on the user's knee, as shown.



Ingenious Column Ruler Saves Time in a Busy Office

THIS time-saving appliance for ruling columns consists of a grooved brass roller set in a handle. It is provided with an absorbent swab that fits into the slot and feeds the roller with a supply of special red ink.

The device is made in three sizes, for ruling one, two, or three columns, and is a great time-saver.

Grass Causes Hay-Fever

DEVIL-GRASS, the curse of lawns in California, is the chief offender in causing hay-fever in that state, according to Dr. George Piness of Los Angeles, who has been carrying on extensive research to find out what caused the trouble. California does not have the ragweed that causes much suffering among hay-fever victims in the East, but a large number of persons are sensitive to the pollen of Bermuda grass or devil-grass.

Know Your Car

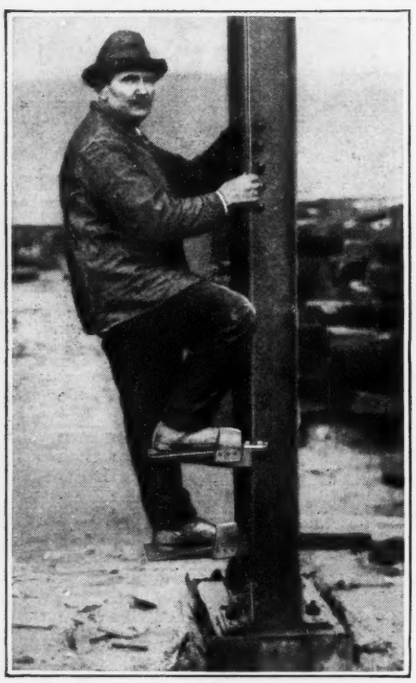
REMARKABLE as it may seem, sometimes the best way to make your car ride easily is to avoid oiling the springs. This applies particularly in sections where the roads are full of "thank-you-marms" or successive depressions and bumps so spaced that the car acquires a forward and backward pitching motion. On such roads, an auto with well oiled springs will pitch so badly that the driver's neck will become tired due to the constant swaying.

It was once thought that failure to oil the springs caused the breakage of the spring leaves, but engineers now claim that a dry spring may be expected to last as long as a well oiled one.

Remember these rules if you want the maximum comfort in driving over rough roads:

1—Pump your tires only to the lowest pressure recommended for the size of tire and the weight you are carrying.
2—Fit good shock absorbers that actually apply friction during the recoil of the spring.
3—Keep your springs thoroughly oiled *if* the car is fitted with shock absorbers.
4—Auxiliary springs will be a help on rough surfaces.
5—Slow down or speed up if the car starts pitching violently so as to get the speed of the car out of tune with the bumps.

Climbs Steel Girders with Patent Grippers



ABOVE is John E. Seaberg of Pittsburgh, Pa., demonstrating a simple but clever device he has just invented to aid structural ironworkers in climbing steel girders. His invention is a pair of wooden clogs equipped with steel grippers that engage the projecting edges of the girder, making it possible to climb as easily as if he were walking up a telegraph pole with its iron spikes. This invention, Mr. Seaberg says, saves much time.

IF YOU have a gallstone, you pay to get rid of it, but there are people in the world who will pay as much as $50 for a good one. Chinese and Japanese are said to hang the stones about their necks to ward off disease and bad luck. A packing plant in Omaha, Neb., collects the gallstones found in slaughtered steers and sends them to the Orient.

New Process Makes Golf Clubs Waterproof and Hard

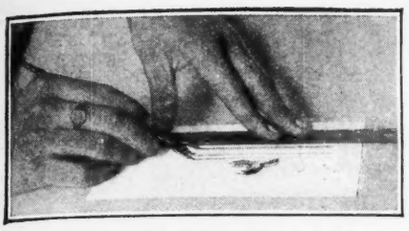
A NEW process for treating wooden golf clubs makes them waterproof and extremely hard. Heads of seasoned persimmon wood are subjected to a vacuum that extracts every particle of air and moisture from the wood, which then is impregnated with the newly discovered chemical. The club heads then are dried and hardened.

Clubs treated in this manner are said to have greater driving power than other wooden clubs and not to shrink or expand with varying atmospheric conditions. Inserted face plates are not required, since the chemically treated wood is itself harder than fiber, bone, or ivory.

Heart-Shaped Glasses Protect Eyes of Movie Actors

IT IS a well known fact that moving-picture actors who have made a number of "inside" pictures frequently are troubled by what is known as "studio eyes." The condition is caused by long exposure to the intense rays of the cluster lights, and frequently an actor has had to take a protracted rest to recover from such an attack. The picture below shows Claire Windsor, famous movie star, wearing the latest thing in "studio glasses," heart-shaped to relieve their otherwise ugly appearance on the wearer. These glasses are made in diamond, square, or spade shape. The lenses are smoked to rest the wearer's eyes as much as possible.

Heart-shaped smoked glasses protect tired eyes



Pen with Three Points Aids Bookkeepers in Ruling

THE tedious work of ruling ledgers and cash books in the small office is much simplified by an ingeniously made pen having a broad nib divided into three points like a fork.

Two of the extra penpoints are quite close together, making the double line for the extreme left-hand column in a ledger.

In a single stroke a whole cash column can be ruled. New nibs can be bought for the pen when the old ones are worn.

Newest Home Trousers Press

THERE have been innumerable trousers presses on the market from time to time, but the maker of the model illustrated at the right claims that his is the simplest of them all. It has no top board and not a single nut or screw goes into its construction. Pressing and stretching are accomplished in one operation. The curved shape of the board is said to insure enough gentle stretching to eliminate bagginess at the knees. Sufficient pressure is obtained with one hand.

WOMEN with dark hair are better automobile drivers than blondes, according to P. L. Emerson, owner of a large taxicab company in Chicago. He related this in conjunction with a statement made by psychologists, who found brunettes more conservative, on the whole, than fair-haired persons.

One-Piece Tennis Suit Gives a Longer Reach

PERHAPS it was the comfort of his swimming-suit or cover-alls that inspired Mr. P. Mundet, a Frenchman, to invent a similar type of suit for playing tennis. It is in one piece and in all except color and length of sleeves resembles a cover-all.

When making long reaches or twisting for a back stroke, a belt about the waist is noticeably restrictive, while a loose, one-piece tennis suit, opening down the middle front, brings comfort, it is claimed, as well as more ease in playing.

One-piece tennis suit is comfortable

Years Ahead in Knowledge

I THINK the magazine wonderful and do not see how a family with growing children could do without it. It puts people who read it years ahead of people who do not.—C. W. C., Franklin, Pa.

Smoking-Tube Is Latest Fad for Fastidious Women

IT'S a headlight when the cigarette is lighted. A vacuum cup holds the cigarette firmly to the rim of the smoker's hat, so that she can smoke with ease and comfort.

The holder with rubber tube can be adapted for use while reading in bed, riding in an automobile, or playing cards.

Smoking a cigarette by long distance

Scientist Says Meat-Eaters Live Longer than Vegetarians

VEGETARIANS received a blow when Prof. James R. Slonaker, a Leland Stanford University physiologist, declared recently that meat-eaters live just as long as their abstaining brothers, in fact, longer. For eight years he has been experimenting with meat and vegetable diets on rats and now is applying his results to human beings.

When the rats were fed vegetables only, the span of their lives, he found, was shortened, in males 33 per cent; in females, 40 per cent. Males lost 35 per cent weight, and females from 25 to 28 per cent. By the third generation the non-meat-eaters lost the power of reproduction, indicating that vegetables lack something necessary to health.

THE greatest underground electric power cable ever installed is to be put in New York City to protect the city in fire-fighting. It will be operated at 132,000 volts and will link together the generative stations of the New York Edison Company with its subsidiaries, reducing the possibility of interruption to the Fire Department's pumping during a fire.

How Much Do YOU Know about Science?

THE following questions, dealing with the common facts of science, are the kind that POPULAR SCIENCE MONTHLY receives daily. Look them over and see how many of them you can answer.

Don't let your brain get lazy. Give it the sort of stimulant that these questions offer, and you will find your faculties sharpened and your appreciation of the world's natural wonders greatly enlarged. Now turn to page 135 and see what percentage of the 12 questions you were able to answer correctly.

1. Why do liquids rise in a straw through which you drink?
2. Why do the men near the guns on a battleship open their mouths when the guns are fired?
3. What is invisible ink?
4. How far does the earth move each day in its journey around the sun?
5. Where does the sand on the seashore come from?
6. What are sun-spots?
7. Why does hydrogen peroxide bleach the hair?
8. Why is there no air inside an electric-lamp bulb?
9. How does a whale keep warm?
10. Why must a vacuum-tube filament be hot?
11. What is the tallest tree?
12. Why does your face get white when you are frightened?

What Batteries *Are Best for Your* Radio Set?

How to Save Money and Trouble by Making the Right Choice

By John Carr

ALL radio receivers except crystal sets require a supply of electric current to operate them. And if we are to get the kind of radio reception we want, the sources from which we draw current for our radio sets must be capable of delivering electrical energy in a steady, uniform flow for hours at a time without appreciable change in voltage.

Furthermore, we need two, and in some cases three, different sources of current supply. The filaments of the tubes must be heated, electrical pressure must be applied to the plates of the tubes, and in circuits where it is needed we also must use a third source of energy to keep the grids of the tubes at the proper potential.

Coupled with our desire to secure perfect reception is the need for obtaining satisfactory results at the lowest possible cost and at a minimum of trouble. And it is this matter of trouble and expense that sometimes makes the problem of current supply a decidedly vexing one. Obviously, it does not bother the man who can afford to go to his dealer and arrange with him to see that the radio set always is operating properly, regardless of expense.

For the beginner the question is complicated still further by the fact that there are three types of vacuum tubes in common use today, and each type requires different pressure and volume of current to heat the filament.

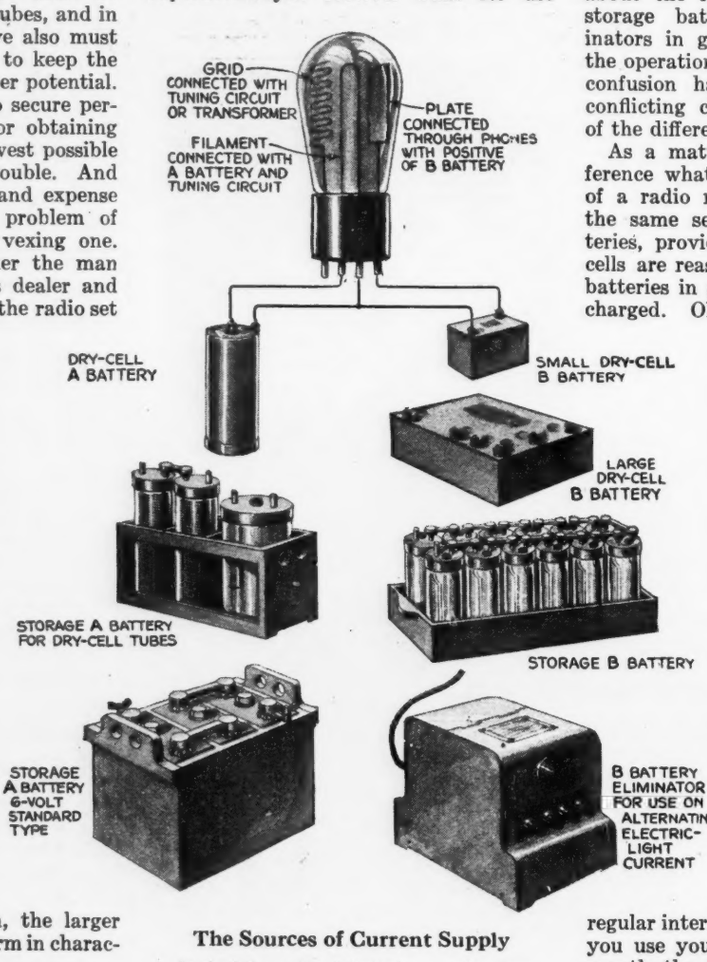
IT SEEMS logical to decide on the type of tube first, and then to study the various ways in which current may be supplied to the filament circuit.

Most people have found that, all other conditions being equal, the tubes that use one-quarter ampere apiece at a pressure of five volts will give greater volume than the tubes ordinarily sold for operation with dry cells. In addition, the larger tubes seem to run more uniform in characteristics.

There is little choice between the two types of dry-cell tubes on the score of operating results, although there is a slight difference in economy. Three dry cells in series are required to operate the .06-ampere dry-cell tube as against one dry cell for the one-quarter-ampere tube. However, the three dry cells last more than three times as long as the single cell used on the other tube.

The mere fact that a certain type of tube is called a "storage-battery tube" and that another type is called a "dry-cell tube," does not mean that the filaments of the tubes necessarily must be heated with current from any particular kind of battery. Storage-battery tubes can be operated from dry cells, and vice versa. It is merely a question of selecting the source of current that will prove most economical of your time and money in your own particular case.

Take, for instance, the typical case of a superheterodyne receiver built for use with dry-cell tubes. Assume that several members of the family use it almost daily, so that the total number of hours of operation a month may be well above the century mark. Under such conditions it is easy enough to prove that a set of storage batteries to supply both A and B current would result in marked economy of operation. On the other hand, the owner of the receiver might figure that the additional care and attention required by the storage batteries would more than offset the saving in money.


GRID CONNECTED WITH TUNING CIRCUIT OR TRANSFORMER
FILAMENT CONNECTED WITH A BATTERY AND TUNING CIRCUIT
PLATE CONNECTED THROUGH PHONES WITH POSITIVE OF B BATTERY
DRY-CELL A BATTERY
SMALL DRY-CELL B BATTERY
LARGE DRY-CELL B BATTERY
STORAGE A BATTERY FOR DRY-CELL TUBES
STORAGE B BATTERY
STORAGE A BATTERY 6-VOLT STANDARD TYPE
B BATTERY ELIMINATOR FOR USE ON ALTERNATING ELECTRIC-LIGHT CURRENT

The Sources of Current Supply

At the left are the A batteries, ranging from the single dry-cell to the standard six-volt storage battery. At the right are the various types of B batteries and B-battery eliminators in common use. The small dry-cell B battery at the top of the column is useful for portable sets, but is not economical for regular use

AMONG beginners particularly, there seems to be considerable confusion about the relative merits of dry cells, storage batteries, and B-battery eliminators in giving satisfactory results in the operation of the radio receiver. This confusion has been caused mainly by conflicting claims of the manufacturers of the different sources of current supply.

As a matter of fact, there is no difference whatever between the operation of a radio receiver using dry cells and the same set supplied by storage batteries, provided, of course, that the dry cells are reasonably new and the storage batteries in good condition and properly charged. Old dry cells that are nearly exhausted sometimes will produce a lot of noises that sound like static. Storage batteries also offend in this respect if the connections become corroded.

If you are troubled with noises in your receiver, however, merely buying new batteries or another type of battery is not necessarily a cure-all. A defective tube or a bad connection in your receiver may be entirely responsible, or the noise may not originate in your equipment at all. Some piece of electrical machinery near by may be radiating energy that affects your receiver like static.

A STORAGE battery requires recharging at regular intervals, depending on how much you use your receiver. At least once a month the level of the solution in the battery should be inspected and distilled water added. This applies to both storage-A and storage-B batteries of either lead or alkaline type.

If electric-light current is available in your home, recharging the storage battery is simple. A variety of chargers are on the market. Some use tubes, others rectify electrolytically, while still others are of the vibrating reed type. The Popular Science Institute of Standards has tested and approved a number of these devices, and any of the approved

types will give you excellent service.

Some of the approved chargers are so arranged that they are capable of recharging either A or B batteries with the same apparatus. Others are made specially for A batteries or for B batteries.

Storage A batteries are made in a number of sizes and the beginner often is unable to decide which size will be best for his own use. The answer all depends on how many tubes are in your set and how many hours a week you expect to use it on an average. If you have your charger wired up to switches so that putting the battery on charge is merely a matter of throwing a switch, it makes little difference whether you have to charge the battery every week or only once every two or three weeks.

GENERALLY speaking, it is advisable to get a battery large enough so that you can charge it regularly once a week—say every Saturday night after you are through listening in. For a small set using not more than three tubes, a 40- or 60-ampere-hour battery is sufficiently large. For a five- to eight-tube outfit an 80- to 100-ampere-hour battery is ample. Remember that an eight-tube outfit using one-quarter-ampere tubes draws only a total of two amperes, and this amount of current will not prove an injuriously rapid discharge rate for even a 40-ampere-hour battery.

Storage-battery operation of the tubes in any receiver designed for use with the dry-cell tubes is practical also for the man who does not mind the additional trouble of taking care of the battery. For 1½-volt outfits that are arranged to operate on a number of dry cells connected in parallel, a single-cell storage battery is used, while a two-cell storage battery is used for the tubes that require three dry cells connected in series.

THE advantages of a storage-battery source of supply for your B current also depend on the number of tubes you are using. A one- or two-tube outfit uses so little current that the large dry-cell B batteries often last for more than a year, and there is certainly no possible advantage in a storage B battery under these conditions. With multi-tube sets, however, it is another story. If you have a five-tube receiver or a "superhet," and use it considerably, the storage B battery will prove an economy, provided you are willing to give it the care and recharging it requires.

In such a case it is easy to make a direct comparison of the actual expense of supplying B-battery current to your set if you will assume some definite number of hours a day as representing the amount of time the set is in use. Three hours a day should be a fair average. Of course, there will be a number of days when the radio set is not used, but, on the other hand, the set will be run all afternoon by one member of the family and until the wee small hours by the owner.

We also have to assume that the set consumes a definite amount of current—say 25 milliamperes. This is more than some five-tube receivers use, and less than most of the "superhets."

Under such conditions, an extra large B battery of the dry-cell type, consisting of two of the 45-volt heavy-duty blocks, will last for about a third of a year. Such a battery will cost in the neighborhood of seven dollars, or a total expense for the year of $21 for B-battery current.

A suitable storage battery for such service will cost around $40 and will last five years or even longer if exceptionally well cared for. This amounts to about eight dollars a year, and to this expense must be added the cost of recharging, which figures out at approximately $2.50 if you assume that the battery will need a 10-hour charge at least once in every two weeks to keep it in good condition and you have a reasonably efficient A-battery charger that can be used also to recharge the B battery.

TWO types of storage B batteries are in general use today—the acid type and the alkaline type. It is claimed for the latter that they will stand more abuse in the way of allowing them to stand discharged, or too rapid charging. While this is true, the lead-acid type maintains its voltage practically unchanged until nearly discharged. Another claimed advantage of the alkaline type is that since it contains no acid it cannot damage the rugs if, perchance, any of the solution is spilled. This claim seems to be unfounded, for the caustic potash it uses will chew holes in a rug just about as quickly as the sulphuric acid in the lead type. Neither type will give you any trouble in this respect if ordinary precautions are taken.

Before deciding on whether storage B batteries are a worth-while investment for you, be sure to study Mr. Senauke's article on page 72 of this issue, explaining the important part the C battery plays in cutting down the amount of current drawn from the B battery.

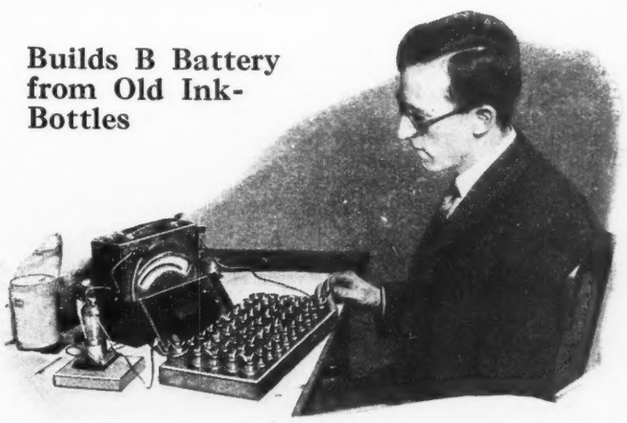
Of the B-battery eliminators on the market today, some are excellent; others do not give results comparable with batteries.

The B-battery eliminator should be considered on a dollars-and-cents basis as a source of current supply. Any claim that a B-battery eliminator will give you better reception than is possible with batteries obviously is absurd. Good batteries will give you a perfect source of current supply, and all that any B-battery eliminator can hope to do is to equal the results obtainable with batteries.

THE advantages of a good B-battery eliminator are apparent. Once installed it will last indefinitely and will require no attention except the occasional addition of distilled water to the electrolytic types and the renewal of tubes in the models that use tubes to rectify the alternating current. This matter of tubes for use in B-battery eliminators is still causing some trouble because the ordinary radio tube does not have a sufficient current-carrying capacity to operate some of the larger receivers. Special tubes adapted to this particular use already are appearing, and these new tubes, of course, can be used in any of the standard B eliminators.

A B-battery eliminator will not work properly always on every type of circuit and under every condition. If you decide to buy the B-battery eliminator, be sure to have your dealer demonstrate it with the set you intend to use.

Builds B Battery from Old Ink-Bottles



INTERESTING experiments can be performed in the home construction of storage B batteries. It is possible to build a battery out of old ink-bottles and pieces of lead wire with a solution of sulphuric acid and water. The illustration shows such a battery built by John A. Clark, head of the Physics Department of Alexander Hamilton High School, New York, for use in his class demonstrations. Such a battery will produce a voltage of two volts a cell, but the home constructor usually finds to his dismay that the capacity of the battery he has built is so small that it will run the radio receiver for only a few minutes before it is discharged completely

Cloth from String Beans

A PROCESS for making coarse cloth from the fibers of string beans was perfected recently for commercial use in Austria. The bean shells are treated like hemp, and the fiber that results can be spun, making a hard but strong yarn.

This new material is expected to offer competition to hempen products. It is adaptable for making materials for which cotton has been used heretofore, and it can be used in making carpets, curtains, upholstery, and saddlery after it has been bleached properly and printed.

Milky Water Appears in Norway

PERSONS living on the shores of Sognefjord, the longest fjord in Norway, were startled greatly by a strange phenomenon. The water, which is usually dark and clear, suddenly became milky and opaque. All of the fish in the water disappeared. No explanation has been found so far for this weird occurrence.

When Is *a C Battery* Worth While?

Remarkable Tests Reveal New Facts about Quality

By Alexander Senauke, M.E., E.E.

Radio Engineer,
Popular Science Institute of Standards

THERE are, probably, thousands of perfectly good C batteries now resting unused in an equal number of homes where radio sets are installed. The owners of these batteries bought them after reading somewhere that there would be a wonderful increase in volume and quality of their reception merely by the addition of a C battery to the circuit. And then, when the promised advantages did not show up in loudspeaker results, the disgusted radio fans characterized what they had read as bunkum and discarded the C batteries.

The trouble is, of course, that the real advantages of a C battery do not always show up in the loudspeaker. For that reason the Popular Science Institute of Standards has just completed a series of experiments designed to show just when and how the use of a C battery benefits the radio fan.

We studied the use of a C battery in an audio-amplifier circuit from three standpoints: First, to find out what effect, if any, the C battery has on quality of reproduction without regard to volume; second, what the C battery does to the volume and, lastly, what value a C battery has in increasing the life of the B battery by cutting down the amount of current used in the plate or B circuit.

Testing Plate Current

Mr. Senauke recording the difference in the total plate-current of a receiver when used with and without a C battery

An amazing fact developed from our tests was that the value of a C battery in a circuit depends largely on the quality of audio transformers used. In our test we used two types of audio transformers. One was a low priced, low quality make, and the other was a high priced type considered one of the best.

The transformers were connected to couple two storage-battery-type amplifier tubes of standard make in the conventional audio-amplifier circuit. The voltage amplification for one stage, including the transformer and one tube, was measured through the range of from 150 to 3000 cycles with a normal signal, first without the C battery and then with one connected in the circuit.

The results of these tests have been plotted in graphic curves as shown at foot of the page. The ideal curve for an audio-frequency transformer really should not be a curve at all. It should be a straight line. No transformer is absolutely perfect, so that the quality of a transformer as an audio amplifier can be determined by noting how much the amplification curve deviates from a straight line. From the results of our tests it appears that a cheap, poor quality audio transformer actually may give better reproduction of voice or music when used without any C battery, providing, of course, that the signal strength is low enough so that the tube is not overloaded. The diagram at the left shows this.

Now look at the right-hand diagram, and you will see what happens where a high grade audio amplifier is used. In this case the quality is just as good with the C battery as without it; in fact, the slight increase in amplification at the higher frequencies may actually improve the quality of the music from many types of loudspeakers that have a tendency to damp out these frequencies.

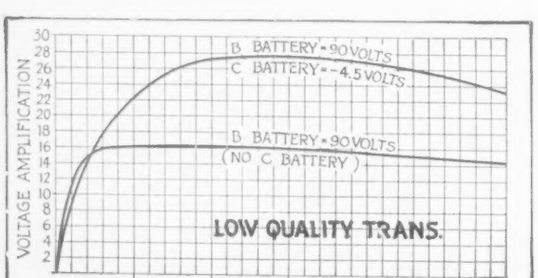
As far as volume is concerned, the C battery helps much more with a high grade transformer than it does with a low grade one. This is especially true if two stages of amplification are used where the cumulative effects of irregularities in the amplification curve are magnified greatly.

From the standpoint of economy of current in the B circuit, the use of a C battery always is desirable. A standard type of storage-battery vacuum tube used in the conventional audio-amplifier circuit with 90 volts of B battery draws about four milliamperes. When a C battery is introduced in the circuit, this current flow from the B battery is cut down to about 1½ milliamperes, so that in the five-tube receiver employing two stages of audio amplification there will be a saving of five milliamperes in B-battery current.

This amount of current saved may be as much as from 25 to 30 per cent of the total current drawn from the B battery and may prolong their life as much as 60 or 70 per cent. When storage B batteries are used, the saving in current is relatively unimportant because storage B batteries must be recharged every so often.

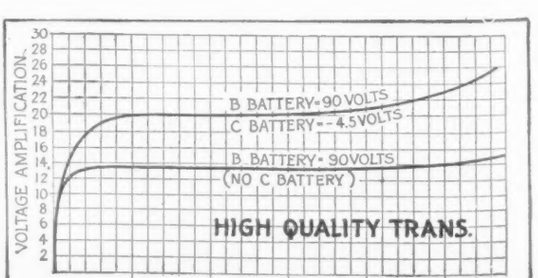
To sum up, our tests show that the C battery is always worth while from the standpoint of economy and that the volume always is increased, at least to some extent. This increase in signal strength is obtained without any falling off in quality except when low grade audio transformers are used, in which case the quality actually may be poorer with the C battery than without it.

THESE tests were made on a signal of normal strength that did not overload the vacuum tube. When a strong signal is being received, the C battery has another advantage. By negatively biasing the grid, the plate-current variations are kept below saturation point of the tube. The C battery, therefore, helps you get volume with the minimum distortion.



How C Battery Affects Quality

The curves at the left show how the use of a C battery may actually degrade the quality when used with a poor audio transformer. With a high class transformer the volume is increased without affecting quality (shown at right)

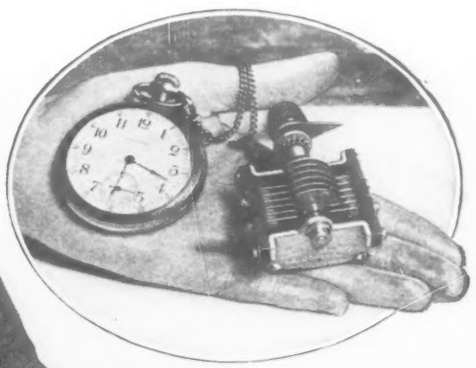


Radio Sparks

Flashes of Progress Made by Fan and Manufacturer

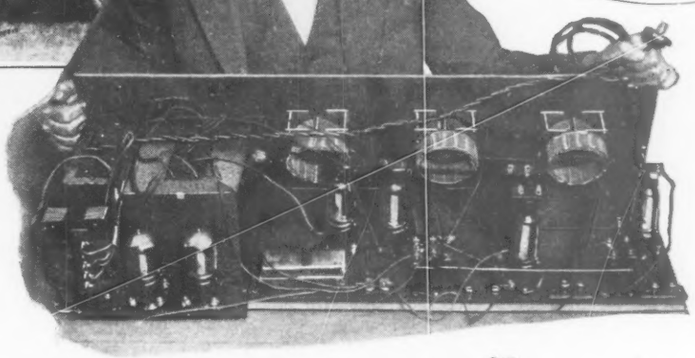
Horse Races Broadcast

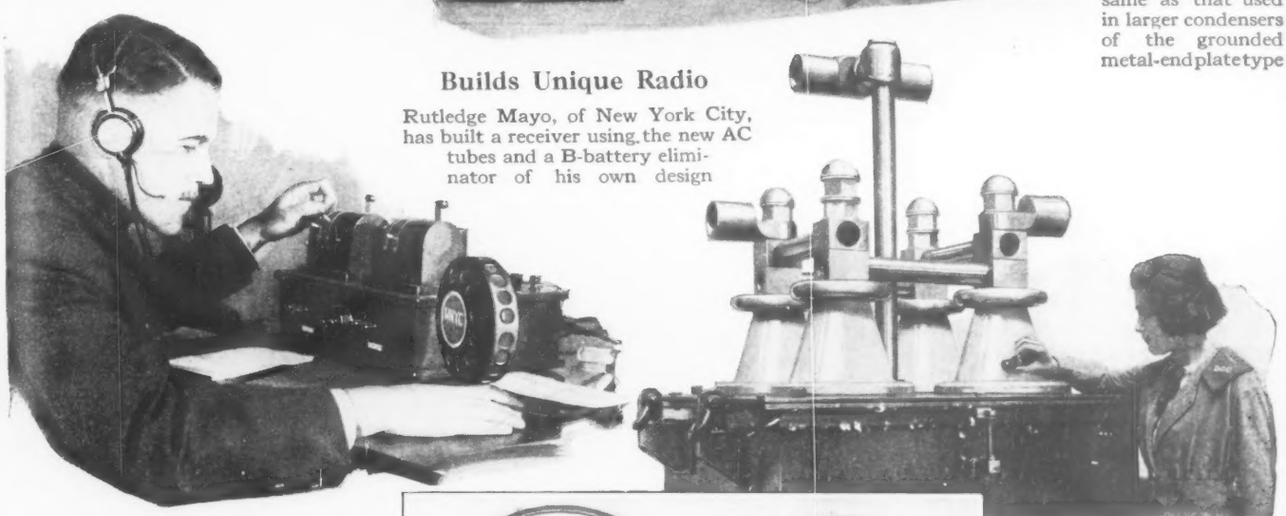
A remarkable portable broadcasting station built into a standard automobile was used recently to broadcast the horse races at Belmont Park, N. Y. The short-wave signals from the portable station were picked up by station WBOQ and rebroadcast on regular wave lengths



A New Midget

Unusually small midget variable condensers now are available to the radio fan for Vernier tuning. Very small variable condensers of this type also are useful as balancing condensers. The construction is the same as that used in larger condensers of the grounded metal-end plate type





Builds Unique Radio

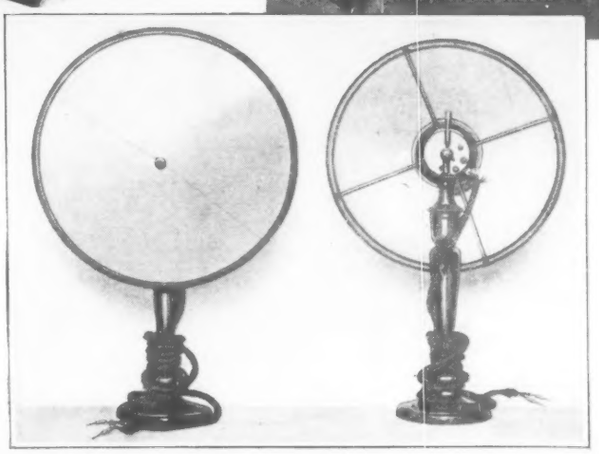
Rutledge Mayo, of New York City, has built a receiver using the new AC tubes and a B-battery eliminator of his own design

Radio Calls Police

The New York Police Department is trying out a wonderful new device that makes it possible to flash signals to all the police stations direct from headquarters. A light flashing up at the receiving set warns that a message is about to be transmitted

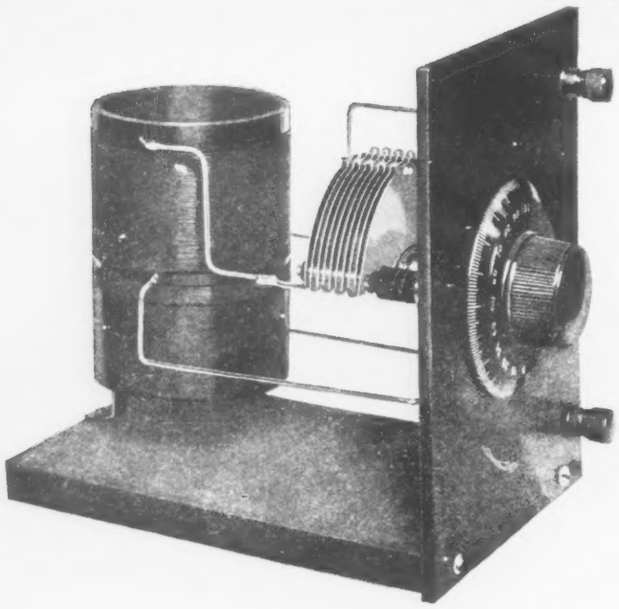
Homemade Loudspeaker

The novel cone-type loudspeaker at the right was made from a candlestick holder, an old-fashioned lamp-shade, a paper cone, and a loudspeaker unit. A piece of bus wire was fastened between the center of the diaphragm and the center of the paper cone



Huge Condenser

The fixed condenser illustrated above now is being installed by an American firm at Rugby, England, for use with the transmitter of the powerful radio station at that point. The tremendous size of this monster condenser can be judged by comparing it with the small radio condenser in the girl's hand. Every detail of the installation of such a condenser must be done most carefully



This view of the wave trap shows how the upper coil *B* is connected with the variable condenser. Notice that ample space is provided for additional turns on the lower coil *A*, if needed

How to Build and Use

A Simple Wave Trap

To Stop Radio Interference

By Alfred P. Lane

THE only trouble with a wave trap or interference eliminator, as it is sometimes called, is that most radio fans expect such a device to perform miracles. And then, when the results are not as expected, the device is promptly relegated to the scrap pile, even if the failure of the wave trap really is due to an incorrect hook-up.

Properly used, a well made wave trap often will help a great deal in eliminating interference from local stations. But you must be prepared, in building the wave trap described here, to experiment a bit until you get it working correctly with your own radio receiver and under your own particular conditions.

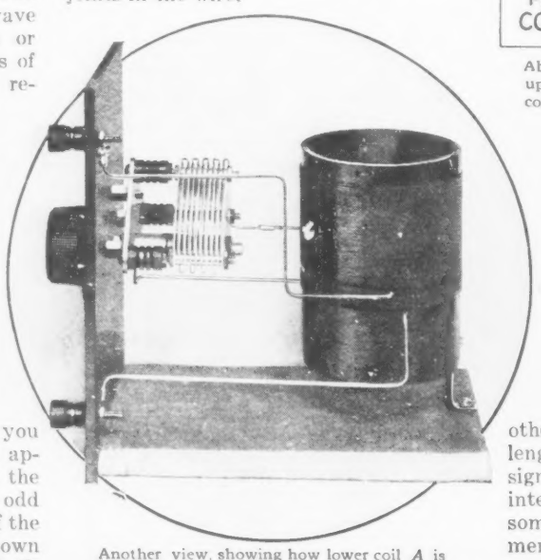
This wave trap, which has been tested and approved by the Popular Science Institute of Standards, can be adapted for use with any type of radio receiver that operates on an outdoor antenna. The circuit used in the receiver has considerable effect on the wave trap. A single-circuit receiver, for instance, requires that the trap be used in the series connection. On the other hand, a wave trap can be used either in series or parallel with the more selective types of receivers such as the three-circuit regenerative, neutrodyne, and so forth.

Whether the series or parallel connection will be best in any particular case can be determined only by experiment. It depends on a number of factors such as the natural selectivity of the receiver, the length of the antenna, and the power and broadness of the interfering wave.

The actual construction of the wave trap is very easy. First study the picture wiring diagram on this page. You will note that you have to purchase only one piece of apparatus, the variable condenser, and the chances are that you will have an odd condenser tucked away in a corner of the workbench that will serve nicely. As shown in the illustrations, the wave trap was built with a composition panel and a wooden base board in the conventional manner, but you can take almost any liberties you like with the arrangement so long as you are careful to keep the variable condenser or any other metal part away from the open ends of the coil.

The capacity of the variable condenser is also relatively unimportant. You can use a 13-plate, 17-plate or 23-plate type. Of course, you must wind the number of turns in coil *B* that will enable you to tune the wave trap to the wave of the interfering station. If you use a coil form three inches in diameter and No. 22 double silk-covered wire, wind about 70 turns of wire for coil *B* if used with a 13-plate condenser. Sixty turns will be about right for a 17-plate condenser, and 50 turns if you use the 23-plate type.

You will have to wind coil *A* to suit the particular conditions under which you use the wave trap. The model shown here has nine turns of wire spaced one-quarter inch from coil *B*. It is best, since the number of turns in coil *A* may have to be changed, to wind on more turns than specified. It is a relatively simple matter to take off turns from any coil, but if you find it necessary to add turns, the only really good way is to rewind the whole coil in order to avoid unsightly soldered joints in the wire.

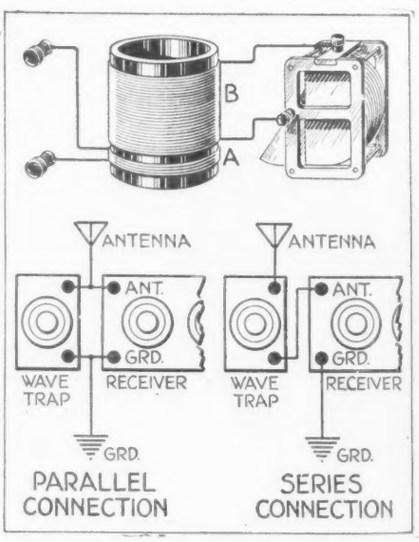


Another view, showing how lower coil *A* is connected with the panel binding posts

After you have mounted the complete coil, the variable condenser, and two binding posts, the wiring will take only a few minutes. Connect the ends of coil *A* with the two binding posts and then connect one end of coil *B* with the binding post on the variable condenser that is connected with the rotary plates of the condenser. The other end of coil *B* goes to the binding post on the variable condenser that is connected with the stationary plates.

The two ways in which the wave trap can be connected with your receiver are shown in the diagram. The best way can be found only by experiment.

In many cases the radio fan is troubled



Above: Pictorial wiring diagram showing hook-up of the wave trap. Below: Two ways of connecting wave trap with receiving set

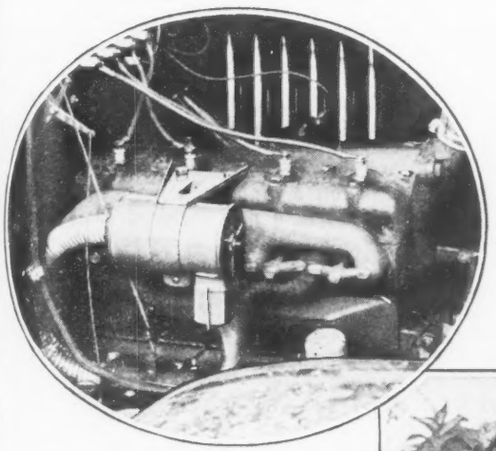
with interference from one particular station that is so near and so powerful that it even may interfere with the reception of other local stations operating on wave lengths 20 meters or more higher or lower than that used by the station from which reception is desired.

When the wave trap is used in the series connection shown above, it is tuned to the wave of the station to be eliminated and all other stations on higher and lower wave lengths still can be received, although the signal strength of the stations nearest the interfering station will be cut down to some extent. Thus the series arrangement is best for use when one station is

(Continued on page 134)

Newest Auto Improvements

Accessories that Add to the Motorist's Comfort



Easily Attached Air Cleaner

Above: Air enters at the rear and is whirled around by vanes. Dirt is thrown outside of the air column by centrifugal force and collects in the detachable box, held by a wire

Automatic Tire Rack

A large spring is concealed in the hollow tube that forms the support of the tire rack illustrated at right. This spring balances the weight of a heavy tire so that a driver can exchange spare and punctured tires without effort

Filler Gage for Ford

Below: This new gage takes the place of the regular filler cap on the gasoline tank and makes refilling the tank a simple matter without removing seat

Lunch-Box de Luxe

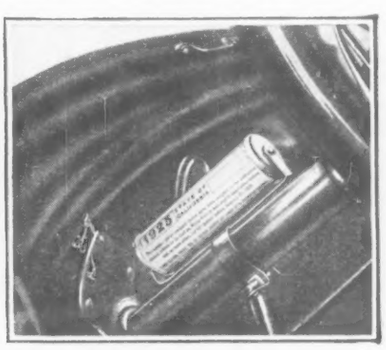
The remarkable chest above holds 35 pounds of ice and enough food for several meals. In fact, with the addition of a stove, it supplies practically everything needed for a portable kitchen. There are thermos tanks for hot or cold liquids

Pedal Extension

Ford owners wearing wide shoes have difficulty in working the reverse pedal without interfering with the other pedals. This device solves the problem simply, as shown

Rubber Bands Steady Car

At right is shown a simple device for cutting down the excessive spring recoil that contributes so much to the discomfort of riding in light cars over rough roads. The specially treated rubber straps are fastened to the frame by clamps



Auto-License Holder

This license holder is clamped on the steering column and the license can be read through the celluloid cover as the cylinder revolves on its axis

The Tricks in Shifting Gears

Gus, the Expert Mechanic, Gives Some Sound Advice to the Beginner Who Comes to Grief on a Hill

By Martin Bunn

GUS WILSON, half owner and chief mechanic of the Model Garage, always claimed that he could tell by the sound of the telephone bell when the party at the other end of the wire was in serious difficulties. It was not strange, then, that he chucked a wrench back into the toolkit and stood up with a yard-long scowl on his face as the telephone rang sharply and insistently. The ringing stopped abruptly, and a few seconds later Joe Clark, his partner, popped out of the office where he kept track of customers' account sand did the bookkeeping.

"Ding bust it!" exploded Joe. "Al Taylor from Ridge Street has got himself all mussed up down at the bottom of Smoke Hill and he wants to be hauled in right away. Can we make it?"

"Make it?" said Gus, disgustedly. "Sure we can. But how about this job for Mrs. Jenkins? You know we promised it this morning. Can you lay off those bills long enough to —"

"Sure," grinned Joe. "That's where I shine as a mechanic—finishing up jobs when all hard work is done."

GUS answered with an unintelligible grunt, cranked up the wrecking truck, and rattled out of the garage with the mudguards flapping like the wings of a bedraggled and much frightened chicken. The wrecking truck was built for service, not for looks.

Smoke Hill, about three miles south of town, was commonly spoken of by motorists as a "cork-puller." A sharp turn at the bottom prevented any chance of rushing the grade, which was mild enough for the first hundred yards. And the ease with which this part of the hill could be negotiated proved the undoing of the inexperienced motorist, for it became gradually steeper and steeper until, near the top, the grade was so stiff that few cars could make it without changing to second or even first.

Gus found Taylor about halfway up the hill. His car was off the road and the smashed mudguard and broken rear wheel jammed against a large oak tree testified mutely to the cause of the accident.

The unlucky motorist rushed over to the truck as Gus applied the brakes and began volubly and excitedly to explain just how it happened.

"No need to go into details, Mr. Taylor. I can see how you got into trouble," interrupted Gus. "This is where you would have to shift into second. I suppose you got rattled and couldn't get the gearshift to work, and while you were fussing with it, the car started rolling backward—and here you are!"

Taylor appeared surprised and a bit crestfallen.

"Then it was my fault? Gosh, I thought something had gone wrong with the transmission, and I was so rattled I never thought to put on the brake until it was too late. Now I suppose I'll have a nice, fat repair bill," he added ruefully.

Gus backed the truck into position to hoist the rear end of the car preparatory to towing it.

In a few minutes the two men had everything shipshape, and when Gus cranked the winch, the rear end of the damaged car left the ground on a perfectly even keel.

"Tell me, Gus, what did I do wrong?" Taylor asked as they drove carefully down the hill in the direction of town.

"Well—no offense meant, Mr. Taylor—but you are a new driver, and almost everything a new driver does is wrong. The thing you did is one that often trips up the man who hasn't had a whole lot of experience."

"Go on," said Taylor, "you can't hurt my feelings. I thought I was the real thing as a driver. Now I know I'm not; so go right ahead, and maybe next time I won't be so dumb."

"You see, Mr. Taylor, gearshifting is mostly a matter of practice and knowing what happens inside the transmission case when you work the lever," said Gus. "Also cars are just like horses. You must be wise to the particular whims of the critter you happen to be driving because no two are exactly alike. That's why a man who can handle one car in fine style often makes noises like a beginner when he is driving another make."

"HUH," said Taylor, a bit peevishly. "Nobody can say that I can't shift gears quietly! I snap 'em in before they get a chance to grate!"

"Sure," Gus went on; "and that is just where you make your big mistake. You 'snap 'em in,' as you say, without any regard for the relative speeds of the gears you are trying to get into mesh, and everything goes fine and dandy until you get caught because the difference in speed is too much. Then they simply refuse to snap in, and you end up by trying to push over a two-foot tree. You ought to be thankful the tree was there to stop you. You might have had a doctor's bill to pay in the bargain!"

Taylor shivered involuntarily.

"That's a pleasant thought," he said, more humbly. "Go on—I haven't any right to be proud."

Gus said nothing for a few seconds, for they were approaching a crossing and the wrecking truck with its trailing load claimed his undivided attention.

"Look at that fellow there who is waiting for the trolley," he exclaimed suddenly. "Watch him when he tries to jump on. See, he stood still and the trolley nearly pulled his arm out by the roots.

"There's a good example of what hap-

GUS says—

1. Always take your foot off the accelerator while you are shifting from first to second or from second to third speeds.

2. Keep your foot on the accelerator when you shift to a lower gear on a hill.

3. Avoid speeding up the car in first—shift to second before the car has gone more than 10 feet.

4. After shifting from first to second or from second to third, be sure that you do not press the accelerator again until the clutch is fully engaged.

5. Never try to shift into reverse gear when the car is traveling forward. Wait till it stops completely.

6. Make sure that the transmission case is filled to the proper level with exactly the kind of lubricant specified by the maker of the car.

pens when you try to shift gears by snapping them in. If the speeds of the two gears are somewhere near alike, they go in with a jerk. If they are not, then they won't go in at all, and that's what happened to you. That man who hopped the trolley could have saved himself the yank on his arm if he had turned and run in the direction the car was going.

"YOU know, of course, that with the lever in first gear the motor in an automobile turns over much faster in proportion to the speed of the car than when the gears are in high. Now, when you throw out the clutch, the motor is disconnected from the gearbox, but the section of the clutch that is fastened to the gears just naturally keeps on turning. That means you have to figure out some way to slow it down when you are shifting from a lower speed to a higher one, or to speed it up if you are changing from a higher speed to a lower one."

"Sounds familiar," said Taylor, smiling. "The man who taught me how to drive used to run off a talk something like that, but I never could understand how to apply it to driving an automobile."

"All right, then," Gus answered, "let's put it in a rule-of-thumb way. Just remember one simple rule: Take your foot off the throttle when you shift to a higher gear and keep it on when you shift to a lower one. This works on most cars, because the slight drag in the clutch makes the free part of it speed up or slow down with the engine. If you remember that one simple rule, then all you have to watch out for is the time interval, and you can get that by practice.

"OF COURSE, it doesn't make any difference to other automobilists on the road whether you tear the whole transmission out or not, so long as you are on level ground, but if you are on a steep hill, it's another story. Suppose there had been a bunch of cars right behind you today!"

"Oh, don't rub it in," said Taylor. "I'm a muttonhead all right. But suppose you just show me how it ought to be done on this hill we're coming to. Then maybe I can get it through my head right."

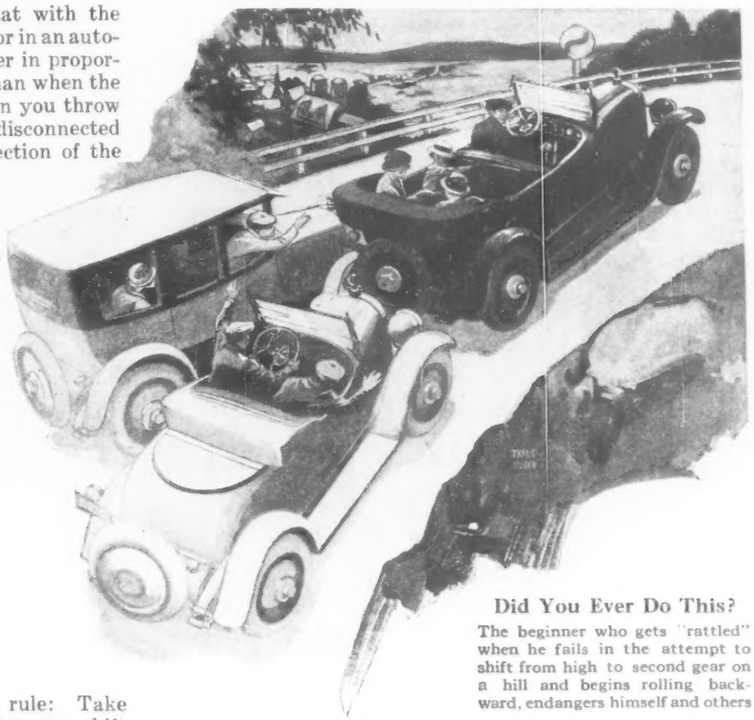
"Good idea," said Gus. "Now you watch carefully. I'll have to shift into second about 100 feet from the bottom."

Taylor kept his eyes glued on Gus's feet. When the engine began to slow up, down went the left foot on the clutch pedal just far enough to disengage the clutch, and almost simultaneously the gear lever went into neutral. The right foot remained on the throttle and when the motor had attained just the right speed, Gus eased the lever into second and released the clutch pedal without a suspicion of clash or jerk.

"Gee, that was as smooth as silk," said Taylor admiringly. "It looks like nothing at all the way you do it."

Gus's wrinkled face creased in a smile. "Just like everything else, Mr. Taylor; it's easy when you know how. As far as auto transmissions go, you can make one last at least twice as long if you treat it right."

A few minutes more and they were in the garage, and Gus busied himself arranging blocks so that the axle would be supported when the car was lowered.



Did You Ever Do This?

The beginner who gets "rattled" when he fails in the attempt to shift from high to second gear on a hill and begins rolling backward, endangers himself and others

"How soon will the **old boat** be ready again?" Taylor asked.

"Well," said Gus, with a quick glance around the garage to check up on the jobs that should be finished before Taylor's, "about Thursday afternoon, I guess—yes, I'll promise it by then. I suppose you will steer clear of Smoke Hill after this," he added, with a twinkle in his eye.

"No, sir!" said Taylor. "I'm going up that hill if it's the last act of my life!"

"Better get in some practice on level ground first, then," said Gus; "and, by the way, Mr. Taylor, if you really want to get into the expert class as a driver you might like to know how to do the 'double clutch.'"

"I'll bite," said Taylor, looking puzzled. "What is it—a joke?"

"Double clutching is no joke," answered Gus. "It's something that most auto drivers know nothing about, yet it certainly is a good thing to know if you happen to want to make the other fellow eat the dust on a bad hill."

Taylor was interested immediately. "Fine!" he said. "Give me all the dope on that. I never did like the taste of dust anyway!"

"I don't know whether I ought to tell you or not, seeing as how you haven't mastered the regular way of shifting gears yet," Gus began. "However, if you'll promise not to blame me if you rip out the transmission trying it, I'll explain double clutching.

"REMEMBER how I shifted into second on that hill? You noticed, of course, that I waited till the old bus had slowed down quite a bit before I tried to shift. Now, if you were trying to race a man up that hill, you naturally wouldn't want to wait till the car slowed down; you would want to make the shift while the car was still going good and fast.

"The only way you can drop from high into second when you are going fast is to use the double clutch. Otherwise you would be almost sure to make a lot of grinding noises.

"Here is how you do the double clutch: The minute the car starts to slow down in high, jam your foot on the clutch pedal and throw the gearshift lever into neutral. Keep the accelerator pressed down hard. Of course, the second the clutch is thrown out and the load of the car is taken off, the motor will start to race to beat the band. With gearshift lever still in neutral, let the clutch in quickly, push down on the clutch pedal again right away, then immediately throw the speed lever into second and let the clutch in again.

"WHAT happens is that while the gear lever is in neutral, the gears you intend to mesh are speeded up by letting the clutch in so that when you push out the clutch and throw her into second there will be practically no clash. That is, if you get the timing right. The only way you can get that is to practice."

Taylor threw up his hands in despair.

"Gosh!" he exclaimed, as he turned to go; "nothing doing on that for me. Guess I'll stick to plain driving. I can't afford a new transmission just for the pleasure of beating some bird up a hill."

"Drat it!" mumbled Gus to himself as he stared after Taylor's retreating form. "Say, Joe, why is it that every bird who succeeds in scraping through the driver's examination decides right away that he is the real thing as a driver and tries to navigate around in heavy traffic just like an old-timer? It would be a lot better for him and for the other fellows on the road if he would spend a lot of time on lonely roads practising gear shifting and maneuvering the car until he really knew how to do it right."

Do You Know Gus and Joe?

THESE two interesting proprietors of the Model Garage appear every month in POPULAR SCIENCE MONTHLY: If you haven't met them, now's the time to get acquainted. You'll find Mr. Bunn's stories not only highly instructive, but entertaining. Next month Gus and Joe will give you some valuable new tips about tires.

Handy Kinks to Aid the Car-Owner

Seven Ways to Save Time and Expense in Auto Repairs

HEADLIGHT bulbs always seem to burn out just when it is least convenient to replace them. Usually the burn-out occurs on a dark road, late at night and during a heavy rainstorm. And to make matters worse the rim of the offending headlight is generally stuck so tight that no ordinary force exerted by the bare hands will suffice to break it loose.

In such cases a powerful "persuader" can be made from a roll of tire tape; white surgical tape is even better. As shown in Fig. 1, the end of the tape is wound around the edge of the headlight rim and the remainder of the roll serves as a handle on which to pull. Short, sharp tugs will be found more effective than a steady pull.

Fig. 1. Tape can be used to start an obstinate headlight rim that is stuck

HERE is a method of bracing the Ford motor to cut out some of the vibration. It keeps the cylinder block from wabbling sidewise. The construction is simple enough. Two turnbuckles are used with the ends bent to fit as shown in Fig. 2.

Care should be used in setting up the turnbuckles, since any excess strain beyond that necessary to get them tight is transmitted directly to the crankcase arms, and if they are turned up too tight a broken crankcase arm may be the result.

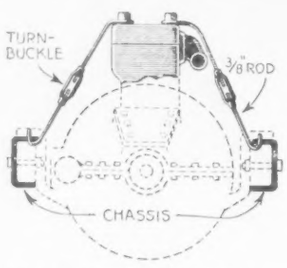


Fig. 2. Turnbuckles used to brace the Ford motor and eliminate some of the vibration

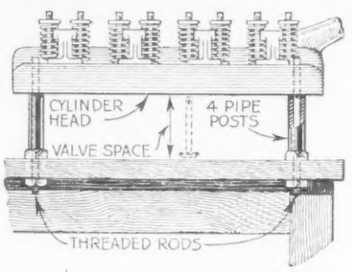


Fig. 3. This method of supporting and holding the cylinder head will aid in removing carbon and grinding valves

THE average automobile owner finds carbon scraping and valve grinding a much more difficult job than it really is, simply because the cylinder head is a rather difficult piece to hold and to work on at the same time.

On overhead valve engines, the valve grinding and assembly of springs and parts can be done much easier if some form of holder is provided for the cylinder head. The method of supporting and holding the cylinder head shown in Fig. 3 will be a big help on carbon-removal and valve-grinding jobs.

In this arrangement, four rods are spaced and secured by bolts through the top of the workbench. This design is particularly good for the amateur workman because the bolts can be removed after the job is finished and put away so that they will be ready for the next time.

The height of these supports should be made sufficient so that the valves can be removed and replaced without disturbing the position of the cylinder head.

RIFLE shooters call the process "sighting-in" when they adjust the sights on their rifles so that they coincide with the spot on the target which is being hit by the bullets. The same system can be used for alining the front wheels of an automobile so as to secure the correct toe-in.

For the average small car, set one wheel so that a sight taken across the inside of the front tire near the axle strikes the center of the tread of the rear tire, as illustrated in Fig. 4. Then look across the inside edge of the other front tire and if you find that the line of sight also strikes the center line of the other rear tire, you can be sure that the front wheels have the correct amount of toe-in.

Of course the test should be made on a level floor and the tires should be properly inflated. Remember also that this rule does not hold good with over-sized tires nor on cars having a longer wheel base than approximately 100 inches.

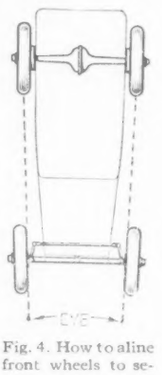


Fig. 4. How to aline front wheels to secure correct toe-in

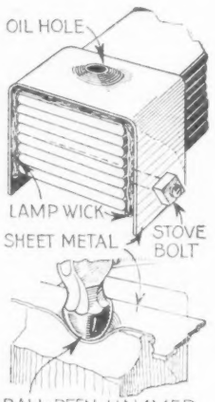


Fig. 5. Serviceable oil clips can be made cheaply and easily from sheet-metal strips and wick

Fig. 6. Hose clamp made from wire and a single cotter-pin

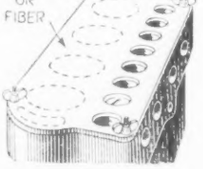


Fig. 7. Simple covers will protect the cylinder while grinding the valves

WHEN the spring leaves are dry, every little bump in the road is transmitted to the chassis of the car. Roads that are full of small bumps, such as cobblestone streets, are negotiated more easily if the springs are kept well oiled. An occasional splashing with old crankcase oil does the work, but it is better to have some means of constantly feeding oil in between the leaves.

Serviceable oil clips for this purpose may be constructed cheaply and easily of some sheet-metal strips, 1 by 7 inches, with three holes in each. Dent down the metal around the center hole, using a ball-peen hammer as shown in Fig. 5. Then when the metal is bent around the spring with a piece of lamp wick under it, the center hole will form a small pocket that projects upward and can be filled from an oilcan.

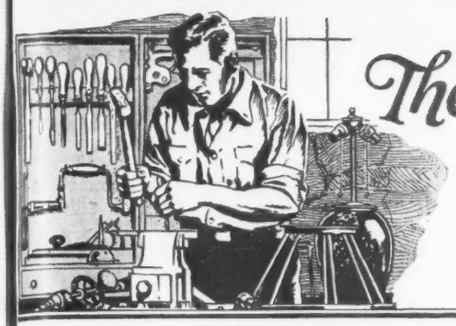
The best way is to have eight clips in all—one on each side of each spring shackle. A little kerosene mixed with the old crankcase oil will make the oil penetrate between the leaves and lubricate them properly.

THE illustration in Fig. 6 shows how to make a very serviceable hose clamp from a piece of wire and a cotter-pin. The brass wire sold on spools for automobile use is suitable, and it is a good idea to use a good sized cotter-pin, so that the strain of tightening the wire will not pull it out of shape.

After the wire is arranged as shown in the drawing, it is drawn tight around the hose by turning the cotter-pin with a nail. An advantage of this method is that the clamp can be made of any desired size.

PERHAPS the most difficult part of valve grinding lies in making sure that none of the valve-grinding compound drops into the cylinders accidentally or down around the valve-stem guides. Part, at least, of the worry on this subject can be eliminated by the use of a cylinder cover constructed and used as shown in Fig. 7.

Heavy cardboard or wallboard will do for the material and holes can be cut at the points where the valves are located. Cylinder-head bolts or studs with winged nuts can be used to hold the cover in place. Another advantage of using a cover over the cylinder openings is that no dust from the air can settle in them.



The Home Workshop

Arthur Wakeling, *Editor*

Fitting Up an Unfinished Attic

How to Reclaim Waste Space in Your House—Setting Joists—the Flooring

By Edwin M. Love

FIRST in a new series of articles containing invaluable pointers on house woodwork for every homeworker

Fig. 1. A typical bungalow of the California type with an unfinished attic that could be converted into an extra room by adding dormer and gable windows, as shown by the dotted lines

IN MANY homes there is sufficient attic space for the building of a needed den or bedroom. If no stairway is present, such a room may be made accessible by means of a disappearing staircase in the hall, or even by a ladder if the room is to be occupied by a man or a boy.

Oftentimes light and ventilation may be had by the use of windows already in the gables, or by substituting windows for ventilators. If, however, there is no direct means of getting light, one or two dormers harmonizing with the architecture of the house may be constructed. Figures 1 and 2 (upper drawing) illustrate these possibilities.

Although each house is a problem unto itself, certain rules of construction cover all cases, so that a careful following of the steps in building an attic room in a typical house will illustrate the principle of any such work.

Ceiling joists usually extend crosswise of a gabled roof, tying the walls. For reasons of economy, in this typical plan it is desirable to run the attic floor joists at right angles to the ceiling joists, making use of the shorter spans, but necessitating their being placed above the ceiling joists. This is desirable even when the floor joists are to be parallel to those of the ceiling, since any weakening of the timbers because of cutting for electric wires is avoided. As the greatest span in 12 ft., 2 by 10 in. fir stock is used, but local ordinances may demand heavier scantlings than these. All should be sized to a uniform width.

Pass up through the hall scuttle a number of the planks and distribute them as in Fig. 5, page 110, to serve as a working stage. Drop a plumb bob from the ridge comb (a weight suspended from a cord is sufficiently accurate for this purpose) to determine the center of the room, and lay out the width, which in this case is 11½ ft.

For bearings for the floor joists, fit 2 by 4 in. blocks on the bearing plates, using two thicknesses, which should rise above the tops of the ceiling joists ½ in., giving clearance for the beams. Lay off distances of 16 in. from one side, making an X beside each mark to show on which side the joist is to bear. The space at the other side of the room is less than 16 in., but if no great load is to be carried, the distance may be divided to save the extra joist shown in the photograph (Fig. 3).

Remove the roof braces shown in Fig. 4. Select a straight joist and set, crown edge up, at one side. Test for levelness by means of a straight-edge and level. The ends of the straight-edge should be supported by blocks of equal thickness to avoid errors due to curvature in the joist, as shown in Fig. 2. It is preferable to cut away the bearing edge of the high end, but if this brings the beam in contact with the ceiling joists below, shim up the low end with a strip of wood.

(Continued on page 110)

This month's Home Workshop Department will be found on pages 79 to 82 and 88 to 111, The Shipshape Home on page 86, and The Better Shop Methods Department on pages 84 and 112 to 120.

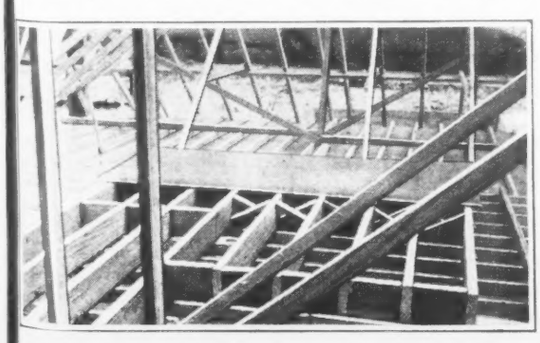


Fig. 3 (at left). Model showing framework of flooring laid to center of room prior to nailing the upper ends of the herring-bone bridging

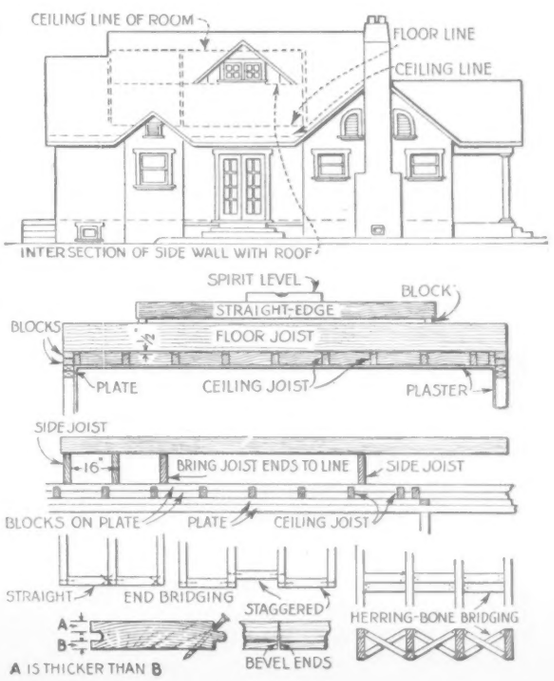


Fig. 2 (at right). House with added attic room and details showing methods of setting and bracing floor joists, bridging and laying the floor

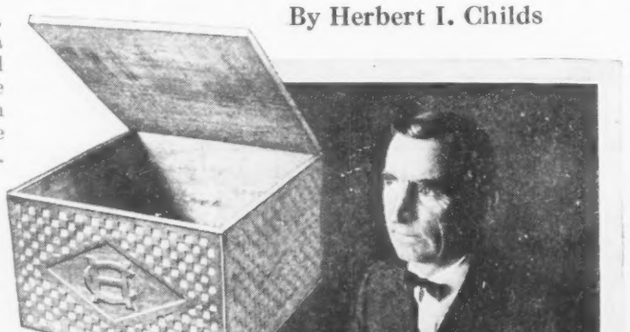
Carving *with Your* Pocket-Knife

Simple Checker-Board Ornamentation for Small Boxes

By Herbert I. Childs

YOUR jack-knife, a hammer, and a few nails are all you need to make these handy little boxes with their decorative checker-board pattern.

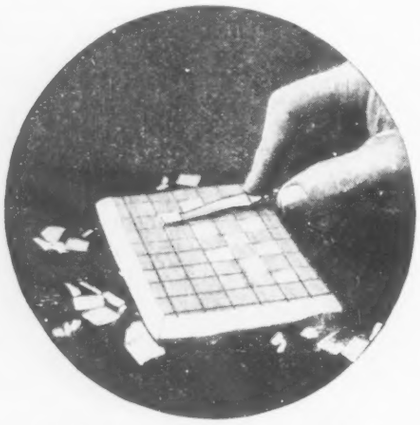
The same pattern can be applied to a great many articles — picture frames, vanity boxes, smoking cabinets, book ends, stationery racks, and all sorts of woodwork. For any one who has not discovered the fascination of jack-knife work and wishes to learn to whittle, this type of carving will commend itself because of its simplicity.



Herbert I. Childs, of Worcester, Mass., an authority on pocket-knives and the almost lost art of whittling, and a vanity box he carved to illustrate the very simple and effective checker-board pattern he describes in the accompanying article. Other articles on useful pocket-knife work are to follow

Butternut wood was used for the handy little toolbox illustrated in the right-hand column, because it does not split easily and the grain is generally straight. It is easy to work with and, when finished, its color looks like some of the harder woods. However, any clear, fine-grained wood, such as white pine or basswood, is suitable. White pine was used for the smaller vanity box shown at the top of the page.

Make the box for your own requirements. With pencil and ruler or try-square, draw squares of about ½ in., leaving a border around the outer edge. A touch of beauty and artistic workmanship is added if a square or diamond is marked out in the center of the pattern. This should be in good proportions to the squares, as in the illustrations. Your initials will look well within the central space.



Wedge-shaped chips are removed from alternating squares after scoring lines

Cut every line to the depth of about ⅛ in. with a small, sharp blade of your pocket-knife. Then carve out the alternate squares, beginning at the bottom of each square and tapering in toward the top until upon reaching it you have cut to the depth of a full ⅛ in. This will be understood better if you will glance at the cross section in the drawing at the right.

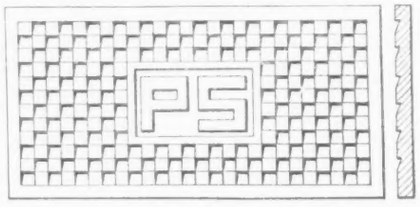
Your initials may be cut in or raised. If to be raised, cut out the surface around them as far as the border to a depth of ⅛ in.

Sandpaper the flat surfaces of the box and finish with shellac, wax, or varnish. The wood can be stained, if you wish, before the finish is applied.

For the sake of your knife as well as your work, do not use a dull knife. As soon as it does not cut clean, sharpen it. Use a fine grain oilstone with a flat surface, upon which a few drops of clean oil have been placed. If sharpened on a dry stone, the edge is likely to be rough.

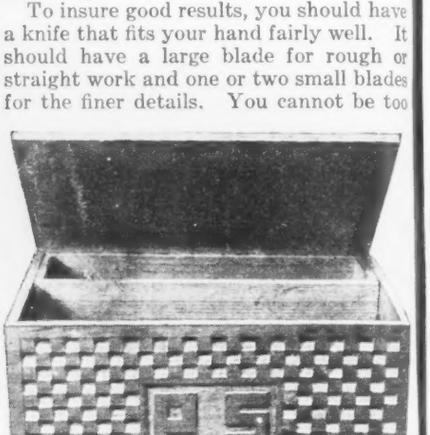
For general use, the edge of the blade should rest on the stone at an angle of about 20 degrees. Draw it from heel to point across the stone from right to left; turn the blade over and draw it across from left to right. The stroke is always against the cutting edge and not with it, as is the case when stropping the blade on leather. The beginning of a stroke from left to right is illustrated above.

Keep up the sharpening process until the edge is keen. This may not come to you at first, but after you have tried it a few times you will see the advantage of taking this care in setting the edge. If the blade is too flat in relation to the stone, the edge will be too thin for strength in ordinary use. It is sometimes desirable, however, to sharpen with a thin edge when very light, thin cutting is to be done. On the other hand, if the blade is held at too great an angle, it will not cut properly, as the shoulder will strike the work before the edge when the knife is held in the natural manner for whittling.



Suggestion for laying out the front of a box with initials in a central rectangle

To insure good results, you should have a knife that fits your hand fairly well. It should have a large blade for rough or straight work and one or two small blades for the finer details. You cannot be too careful in your selection, for you cannot get good results from a poorly manufactured knife.



A small toolbox of butternut wood decorated with checker-board chip carving and initials

The first essential is a knife with a fine quality of steel in the blades, accurately tempered to a hard, high, and tough temper. The blades should be carefully ground with truly tapered sides. Many knives on the market are of a low grade of steel, poorly tempered and ground, and have no value for whittling and carving work. Avoid these and select one of the high grade, American-made pocket-knives, which can be made as keen as a razor.

A GOOD knife will be sharp when bought and for a long time should require only an occasional touching up of the edge on an oilstone. Unless a pocket-knife is permitted to get into very bad shape, it should rarely require grinding.

While the usual spear-shaped blades in the regular jack-knife are suitable for general whittling, it is useful for special carving to have a narrow, straight-edged, small blade with a long point, the back curving down to the straight edge. This is called a "Wharncliffe" or "sheep's foot blade." A so-called Sloyd or modeling blade usually has sides that do not begin to slope toward the edge until about halfway across the blade. With its thick, heavy back, this also is known as a saber-shaped or full-swaged blade. A clip-point blade is one that is similar to a Turkish sword or scimitar, the back half being hollow ground or concaved before reaching the point.

How *to Repair an* Electric Iron

When the Heating Element Burns Out, It Can Be Mended by Joining the Ends of the Broken Resistance Wire

By Leroy S. Foltz

Professor of Electrical Engineering, Michigan Agricultural College

"I WONDER what's wrong with the electric iron? It won't heat up." How often this complaint is heard! Yet a modern electric iron is practically indestructible and hardly anything can go wrong with it that cannot be repaired quite easily by any handy man.

When an iron fails to heat, the break in the electric circuit may be either in the cord or within the iron itself. It is well to test the iron with another cord, if one is available; otherwise examine the cord with care, especially near the attachment piece. Take the cover off the attachment piece and see if the wires are connected tightly with the terminals. If you have any further suspicion of the cord, test it by the means previously described in POPULAR SCIENCE MONTHLY ("How to Test and Repair the Cords of Household Electric Appliances," July, 1925, page 92).

When you are certain that the difficulty is within the iron, the first step is to dismount it. This necessitates removing the parts that interfere with the exposure of the heating element. Figure 1 shows the initial step in removing the handle; Fig. 2, the removal of the terminal block. In some types of irons the terminal block and handle need not be removed.

Next, take out the main assembly screws, which hold the top of the iron in position. This will allow the top to be lifted off and the element to be exposed.

An examination of the heating element will reveal the location of the trouble. In this case the element has burned "open," as shown in Fig. 3. It is necessary to connect these two ends in such a way that the joint will not melt when the current is applied. To accomplish this, unwind the wire ribbon each way to the other side of the element (Fig. 4). Clean about 2 in. of each end thoroughly with a piece of emery or fine sandpaper.

Now form one end into a flattened coil of two or three turns and insert the other end into it. Reduce the size of the turns and pull up the slack in the wire. With the pliers, flatten the coil firmly down on the inserted end of the wire, as in Fig. 5. Be sure to have the coil flat so that projections will not wear holes through the adjacent mica. In order to prevent the joint from interfering with the wires on each side, it is well to insert a small sheet of mica under it, as in Fig. 6.

The element now may be tested by applying voltage to the terminals and noting how the joint performs. If it becomes excessively hot, it should be adjusted to give a larger and more uniform contact between the wires.

When the iron is reassembled, the pressure put upon the element will improve this contact. Be sure to have a little extra mica both above and below the joint—between the element and the top and bottom of the iron.

In case the resistance wire has become so badly damaged that it cannot be repaired in this way, it will be best to discard it entirely and to purchase a new heating element. These come fastened between sheets of mica, ready for insertion.

Steps in Fixing an Iron

These illustrations show graphically the steps required in fixing an electric iron. This is one of the most frequent, as well as one of the simplest, repairs the home worker is called upon to make

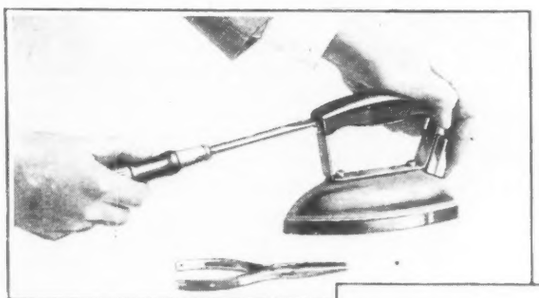


Fig 1. To disassemble the average iron, it is necessary to remove the handle. This is not required, however, with some types of irons that are so designed that the element can be uncovered quickly

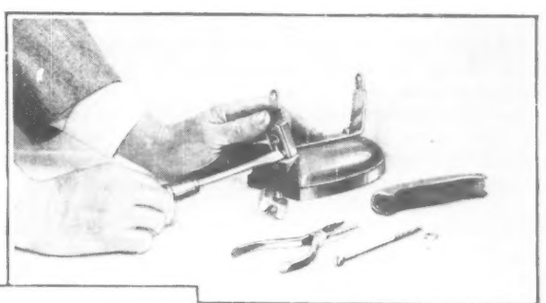


Fig. 2. Having removed the handle, the next step is to unscrew and detach the terminal block. Then remove the main assembly screws, which allows the top to be lifted off and the mica insulation removed. Screwdriver and pliers are the only tools required. Whenever taking apart any electrical appliance, make a careful mental note of the exact position of each piece before removing it

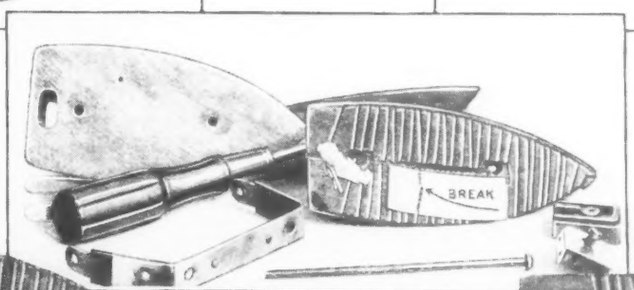


Fig. 3. A typical heating element, showing a burned-out or "open" spot

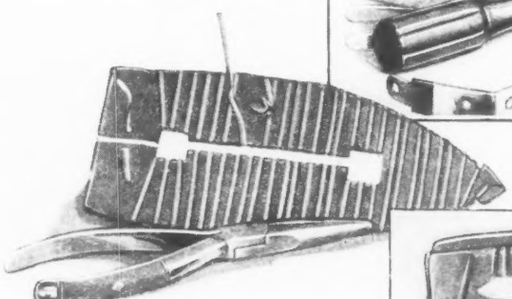
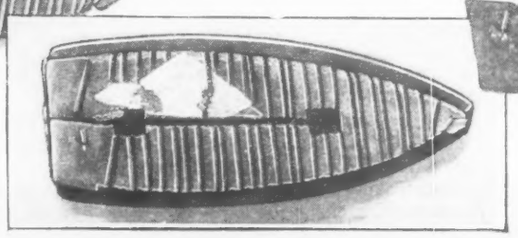


Fig. 4 (above). The resistance ribbon at the break or "open" is unwound to the other side of the form in order to give free ends about 2 in. long, or long enough so that they can be twisted together



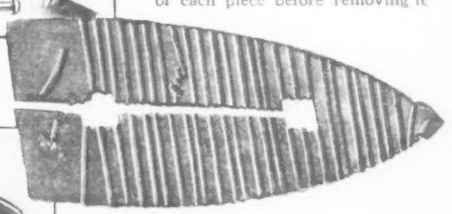
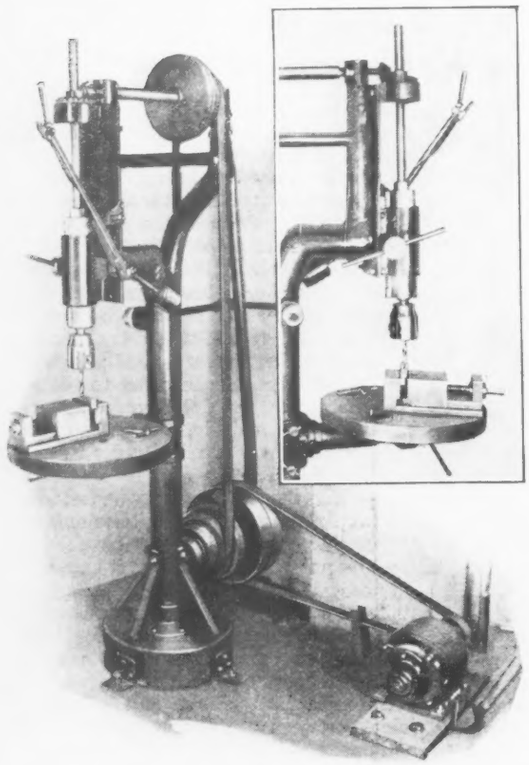


Fig. 5 (above). When connected, the ends of the wire are flattened down with pliers

Fig. 6 (at left). A small piece of mica is slipped beneath the completed joint

Drill Press Built from *Scrap*

Has Seven Ball Bearings Salvaged from Junked Automobiles



By Ray F. Kuns

Principal, Automotive Trades School, Cincinnati, Ohio.

ORIGINALLY designed for a home workshop, the drill press illustrated looked so well when completed that it was placed in a shop, where it is giving complete satisfaction in constant service.

One of the most interesting things about this drill press is the fact that incorporated in it are seven ball bearings, all salvaged from automobiles. In fact, a great part of the material was taken from dismantled cars. With hundreds of thousands of automobiles being scrapped each year, there is an ever increasing field for the use of their parts in building up special garage, machine-shop, or home-workshop equipment.

No attempt has been made to give detailed dimensions. The success of a piece of work of this kind depends largely on the ingenuity of the mechanic in making use of the parts at hand. The main part of the machining may be performed on an engine lathe.

The base *BD* is a heavy brake drum with four pieces of 3-in. angle riveted to it for feet. A hub flange, which has been bored out to receive the pipe *G*, is bolted or riveted to the brake drum.

The frame is built up by welding pipe together. *G* is a piece of 3-in. gas pipe. The curved arm *F* is a piece of 2-in. exhaust pipe, the curve being the original one. *E* also is a piece of exhaust pipe, about 1½ in. The brace E^1 is not added until later.

The table support must be planned before the frame is assembled on the base, unless a split support is devised in place of the cast-iron tee, *I*. The pipe *G* is not turned in the lathe, but simply has any unusually rough spots knocked off with the file. The 3-in. cast-iron tee *I* has a 2-in. outlet for F^1. It is chucked and bored so that it is a sliding fit on *G*. The two ⅜-in. screws *Z* are used to lock the table at the desired height.

The block *N* is a piece of 1-in. steel large enough to receive the ball bearing selected for this point. It is welded to the post, after being bored on the lathe to take the ball bearing.

N^1 is another piece of 1-in. stock and is bored to carry the bearing supporting the other end of the shaft that carries the lower cone *P* and the tight and loose pulleys *M* and M^1. N^1 is welded on a bracket built up to the height of the brake-drum base. *BB* is a length of ¼ by 2 in. flat machinery steel, and the bar *BP* is ⅜ by 6 in. flat steel.

The lower shaft *O* is made up from an axle shaft and has the ends machined to fit the bearings; the other parts are machined to care for the pulleys.

Both cones are the same size and are built up from 1½-in. oak or other hard wood. The particular machine illustrated is provided with both a tight and loose pulley. This allows for connection with a line shaft or individual motor, as shown in the photograph. The pulleys *M* and M^1 are 12 in. in diameter. They may be made from old brake drums.

The table *C* was made from an engine flywheel. It was faced off in the lathe and the edge turned down to 1½ in. thickness. The end of the crankshaft *X* with the flange *Y*, which fits the flywheel, forms the table mounting.

HIS a 2-in. cast-iron tee. If *X* is not large enough to permit boring the tee, it may be bushed by screwing short or close nipples into each of the ends and then the tee is chucked and bored to receive *X* as a sliding fit. The length of F^1 will depend on the swing of the drill. It should bring the center of the table under the center of the drill bit. The screw in the 2-in. tee locks the table in any desired position.

The building of the drill-press head is, of course, the most difficult part. F^2 carries two ball bearings, one in either end. These in turn carry the shaft *A*. Another ball bearing in G^2 carries the driven gear *W*. These three bearings must be in line. The plate *D*, which is a piece of steel plate ⅜ by 6 by 19 in., is welded to the pipe frame.

F^2 may be a piece of 2-in. pipe or tubing. A shoulder is provided when boring to allow the ball bearings to strike it when they are pressed in.

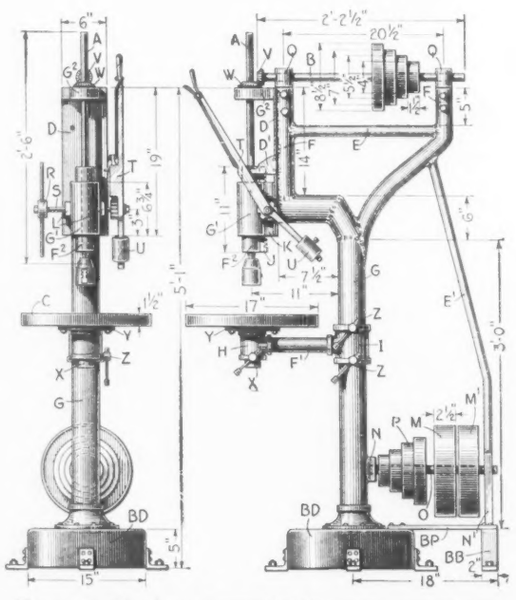
The spindle *A* is machined to assemble from the bottom of F^2 so that it has a shoulder to take the thrust. Ball bearings are usually made to take a thrust in one direction only and this point should be considered in selecting and mounting these bearings.

THE rack *J* is screwed to the part F^2. The shaft *S*, which carries the pinion that actuates the rack, is carried by two blocks of steel, *LL*. One end of this shaft carries a plain lever bar marked *R* and the other end carries a ratchet gear. This gear is engaged and operated by the lever *T*, also salvaged from a car. The lever is balanced by the weight *U*.

G^1 is a piece of tubing with a bore to accommodate F^2 in a sliding fit and machined to allow the rack to project at the rear. It is supported by two strips of angle iron. These strips, *K*, are welded to the tube G^1 and house the rack and rack pinion. They in turn support the blocks *L* and when mounted to the plate *D*, support the entire lower part of the drill-press head.

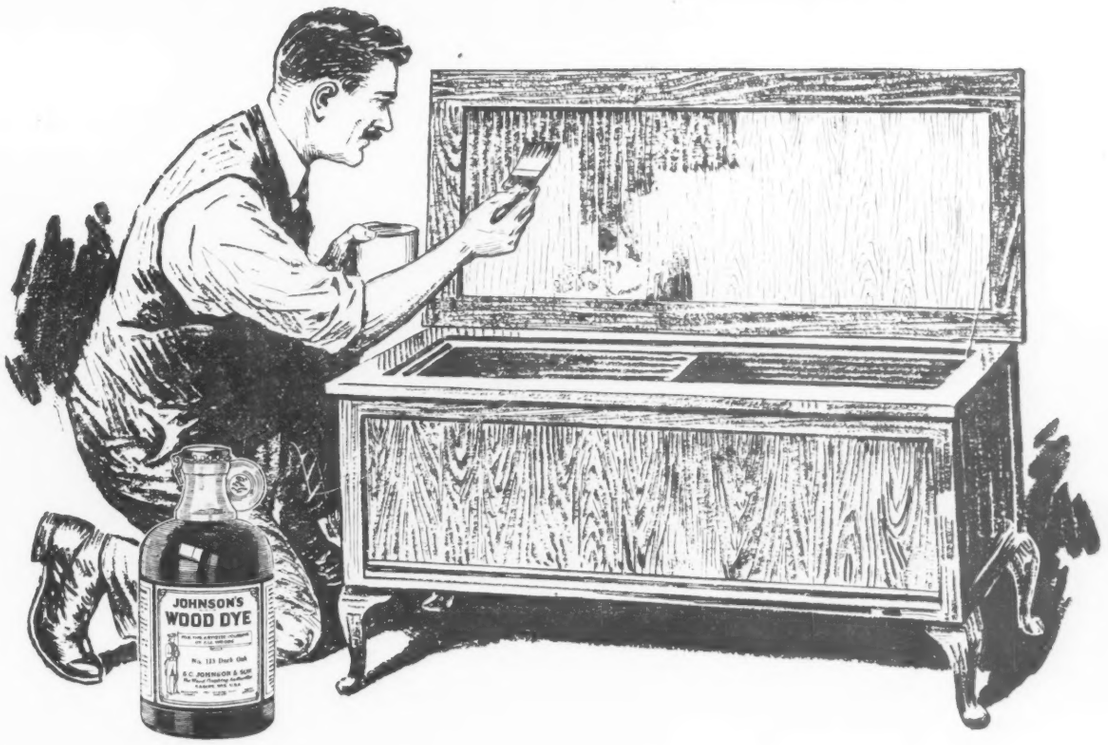
The gears are salvaged from a car. *V* is one of the little gears from the differential. It is a spider gear, and drives a side gear *W*. The ratio is about 2 to 1, which is usual practice. *W* will be found to have a collar-like flange on it, and this

(*Continued on page 108*)



Front and side views of assembled drill press made mainly of material reclaimed from the automobile junk yard

How to Finish Furniture —New and Old



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"The Wood Finishing Authorities" *(Canadian Factory: Brantford)*

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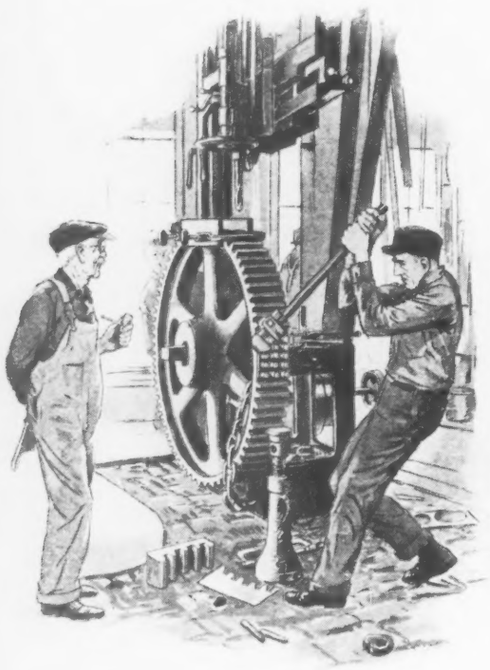
Better Shop Methods

How Expert Mechanics Save Time and Labor

Chasing *a Difficult* Thread

Old Bill Repairs a Pump and Renews a Gear

By James Ellis, *Machine-Shop Superintendent*



OLD BILL put down the trade paper he was reading. He rarely found time to read anything for more than a few minutes before some one opened the door that separated his office from the noise of the shop.

"This pump I am working on—" began the machinist who had entered.

Old Bill smiled and nodded. He knew the job. It was a duplex steam pump that had been sent to the shop for a general repairing.

"One of the water valve seats," the machinist went on, "has come out of the casting, and the threads are all worn off."

Old Bill followed the mechanic out of the office, for he had promised to have that pump back in service on the following day. It was mid-afternoon, and here was something else to be done.

The pump was on a big radial drill press, having the seats faced off. The tools for facing the seats were something like an end mill, except that the teeth went entirely across the face. There was a pilot to go into the hole in the middle of the valve seat, and a shank to fit the drill-press spindle.

"I had them all done but this one," the machinist said, "and about the time I got the cutter in contact with it, I noticed that the seat turned. I stopped, and it came out with my fingers. The threads are gone from the casting as well."

Old Bill saw that the brass seat had only the semblance of threads, and the casting had been attacked so much by rust and by the slight movement of the seat that it had no threads at all. And the pump must be delivered the next day!

Old Bill knew that he could build up the brass valve seat with a welding rod and rethread it again without much trouble, but to get some threads into the pump casting was another question. The cylinder and the frame were one casting, so chasing a thread in a lathe was out of the question. He thought of taps. But when he measured the valve seat, he knew that he had no tap that was 4½ in. in diameter.

"How about reaming the hole and driving the valve seat in?" the machinist suggested. "Some of them are made that way."

"We might make a tap," ventured another mechanic, who had stopped to look.

"I promised to have this pump done in the morning, and we should not be able to make a tap in that time, even if we could find a piece of steel already annealed," Old Bill said. "I believe the best way will be to chase another thread and screw the valve seat back in."

One man opened his mouth; the other closed his eyes a trifle.

Old Bill handed the valve seat to the machinist on the job and said, "Get the welder to build up the thread right away." The mechanic reluctantly left on his mission, for he was anxious to hear the idea Old Bill had in mind.

"WE WILL chase the thread here on this drill press," Old Bill told the machinist who remained. He smiled at the incredulous look of the machinist and continued, "Don't scowl so! All you have to do is to make a boring-bar with a thread, and a guide with a threaded hole that you can bolt across the top opening."

Old Bill looked around the base of the drill press. There had accumulated a mass of bolts and clamps that were used to set up work. He selected a bar about 1 by 3 in. and something like 2 ft. long.

"This will make the guide," he said as he laid the piece over the top of the chamber. "Now get a threaded hole about here." He made a mark on the bar just over the worn hole. "I think that we had a 1½-inch tap with eight threads to the inch made for some special job. If you can find that, it will be fine. Then make a boring-bar to fit the threaded hole. You can turn a straight shank on it and hold it in the drill chuck. Hold the tool with a setscrew."

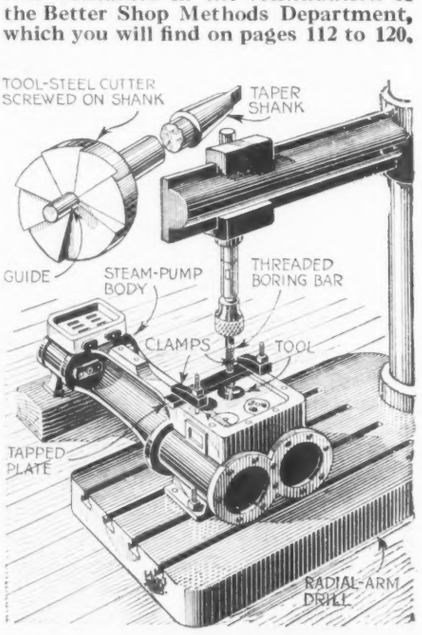
The machinist grasped most of the idea. Old Bill went on: "I forgot to say that you should hold the guide bar on the chamber with some of the studs that hold on the cover. They are right where you want them."

This was something new to the machinist, but he set to work to get the parts ready. The other machinist was back by this time, and after the idea had been explained to him, he started to make the boring-bar. With two men at it, the tools were soon well under way.

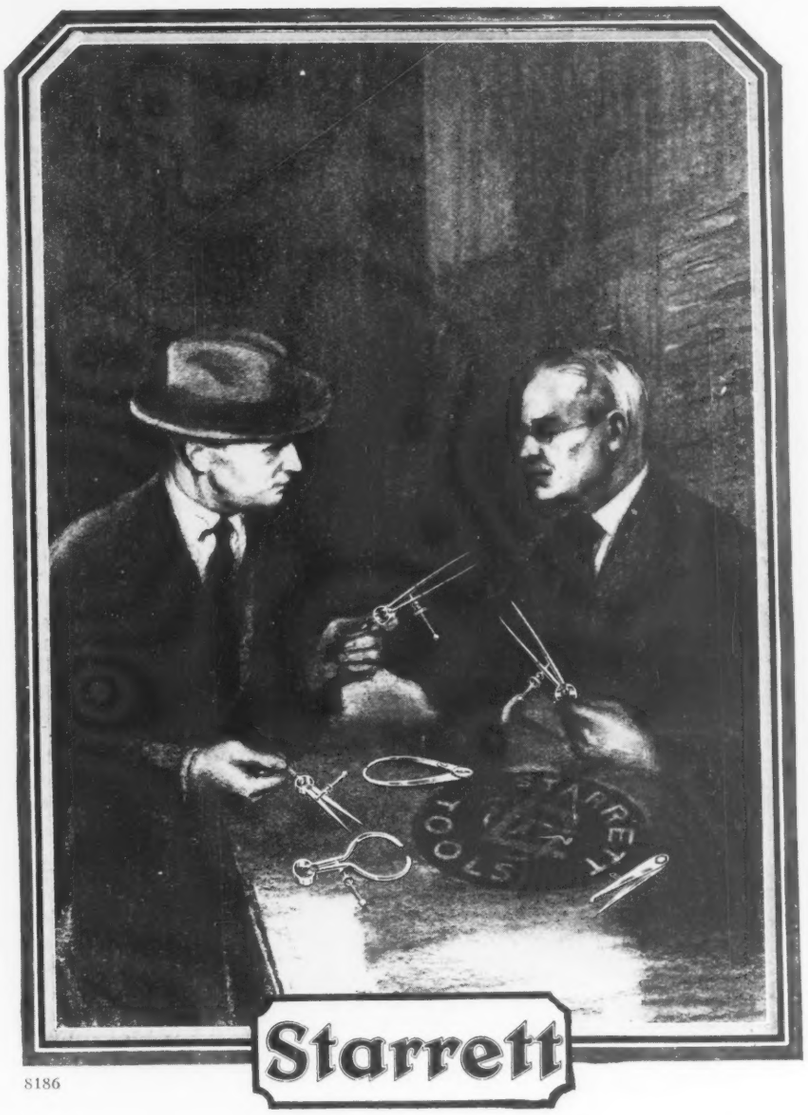
Old Bill, resisting the lure of the article he had been reading, made the rounds of the shop and came to a gear about 4 ft.

(*Continued on page 115*)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 112 to 120.



Radial drill set up for threading, and facing tool with teeth neither radial nor evenly spaced



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Why Do Good Hardware Stores Everywhere Sell Starrett Tools

Calipers and Dividers

Compare Starrett Calipers and Dividers with other makes and you will begin to see why Starrett Tools are preferred by particular mechanics everywhere. You'll find them made from a fine quality steel, tough and nicely tempered. The legs are strong, the springs have just the right stiffness for rapid, easy work, yet *holding* a given size faithfully. Set a pair of Starrett Calipers or Dividers in the morning and they stay set all day. The adjustment is particularly sensitive. Once you are accustomed to the "feel" of your Starrett you can work to surprisingly close limits. Caliper points are nicely shaped—divider points unusually accurate. Threads on nut are absolutely true.

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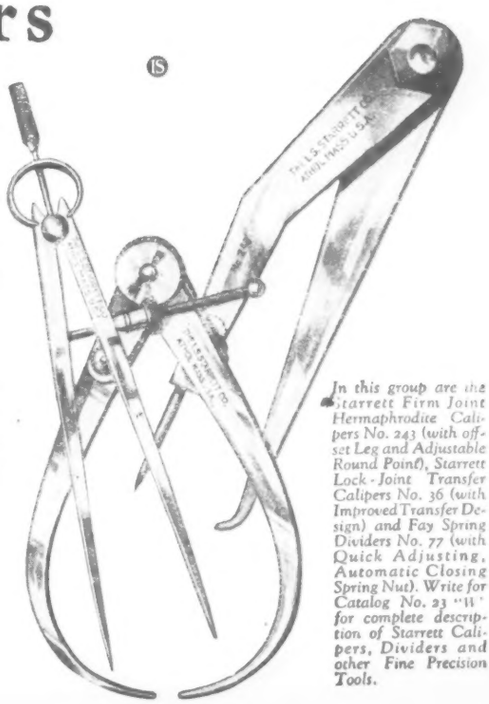

In this group are the Starrett Firm Joint Hermaphrodite Calipers No. 243 (with offset Leg and Adjustable Round Point), Starrett Lock-Joint Transfer Calipers No. 36 (with Improved Transfer Design) and Fay Spring Dividers No. 77 (with Quick Adjusting, Automatic Closing Spring Nut). Write for Catalog No. 23 "W" for complete description of Starrett Calipers, Dividers and other Fine Precision Tools.

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The Shipshape Home

How to repair shingle, composition, slate, and metal roofs—A simple "creeper"—Painting roofs

How to Repair Leaky Roofs

MANY a home-owner who takes pride in keeping his house shipshape is at a complete loss when it comes to roofing repairs. This is natural, because the roof is usually an inaccessible and awkward place to work. Yet, a little care given to your roof, whether it is shingle, composition, slate, tile, or metal, will repay you greatly.

By looking after a roof from year to year, its life can be preserved surprisingly and, of course, the annoyance and often costly damage caused by leaks can be avoided.

There is nothing especially difficult in repairing a roof, provided you know how to go about it. If you have a shingled roof and it leaks, go into the attic and wherever daylight shows through, drive small splinters of wood up into the cracks. These will indicate the cracks when you are working on the outside. If no light is visible, note the approximate location of the tell-tale damp spots.

Put your ladder up outside and set your "creeper" or roof scaffold in place. If you have no creeper, by all means make one, as it will be useful for years to come. In case of a roof fire it may aid greatly in reaching the flames.

Almost any board that is as long as the roof from the eaves to the ridge will serve as a creeper. Nail cleats to it about 1 ft. apart. The upper end should have a hook as shown; this can be purchased or forged from an iron bar. Bolt it securely to the creeper. After placing the hook over the ridge, always test by pulling down sharply on the creeper before trusting your weight on it.

FIT new shingles into any places where the old shingles are out, nailing them in place. Where the shingles merely are split, slide pieces of tin or galvanized iron under them far enough so that the upper part is under the top course of shingles. Nail down all loose shingles and replace any badly damaged ones.

A coat of good shingle paint will aid in preserving the roof. A very economical paint can be made by mixing 5 gals. colored creosote shingle stain, 3 gals. old auto oil and 2 qts. of Japan drier. Mix more or less, according to the size of your roof, but use the same proportions. Brush on exactly as paint. By adding aniline dyes of the shade desired, almost any color, if not too light, can be obtained. I should not recommend this paint for shingled side walls, as it would remain tacky for some time.

If your roof is of the composition shingle type, mark the leaks as for wood shingles, or note their approximate positions and proceed in the same way, except that a small dab of roofing cement the color of the shingles should be applied over each nail. If you cannot obtain roofing cement of the right shade, mix asbestos fiber, which can be had from almost any plumber or steamfitter, with a paint of the proper color until a putty-like paste results. This filling for small holes and cracks will last for years and will remain flexible.

If the shingles have dried out or the surface has gone, there are a number of colored paints with an asphalt base that may be used to renew the life of the roof. Under no circumstances use paints with a linseed-oil base on a paper roof as such paint will destroy its weather-resistance.

Using a "creeper" in repairing a shingled roof. A tool for removing broken slates

If your roof is slate or tile, an entirely different method of repair is necessary. Go over the surface of the roof carefully and remove all slates that are cracked crosswise of the slate. Use the tool illustrated, which any blacksmith will make for a dollar or two, or which can be purchased from a hardware dealer. It is called a "ripper."

INSERT the working end under the broken slate and move it back and forth until the nail holding the slate in place is firmly seated in one of the hook-like notches. Then by jerking down sharply the nail can be cut. If it is too stubbornly set, the upper end of the handle may be hammered.

In the crack or joint directly under the slate that has been removed, nail a piece of copper or soft brass about ½ in. wide and 4 in. long in such a way that the lower end will project 1 in. below the lower line of the course where the new slate is to go. Then slide the new slate up even with the other slates in this course and bend the copper clip up in hook fashion. This will hold the slate permanently in place.

If a slate must be cut, lay it along a stone step or a square piece of iron and cut it with an old file or hatchet by using short, sharp blows. Holes can be punched with a sharp nail or punch. If any large amount of slate must be cut, it is best to employ an experienced slater or to purchase a set of slater's tools, which consist of a hammer, ripper, and stake. The latter is a T-shaped, flat steel anvil.

If your roof is tile, by all means get an experienced roofer. Tile roofs are difficult to repair because the tile must be laid to allow for expansion.

Metal roofs are perhaps the easiest for the amateur to repair. Solder or cement all small holes or cracks and then paint them with a good grade of iron oxide or red lead paint. If the roof is loose, fasten it down with large headed screws and solder or cement over their surface.

To do a good job of soldering a metal roof, scrape the metal until dry and clean and use a good flux (muriatic acid for galvanized roofing and rosin for tin roofing). Solder heavily with a clean, hot iron.

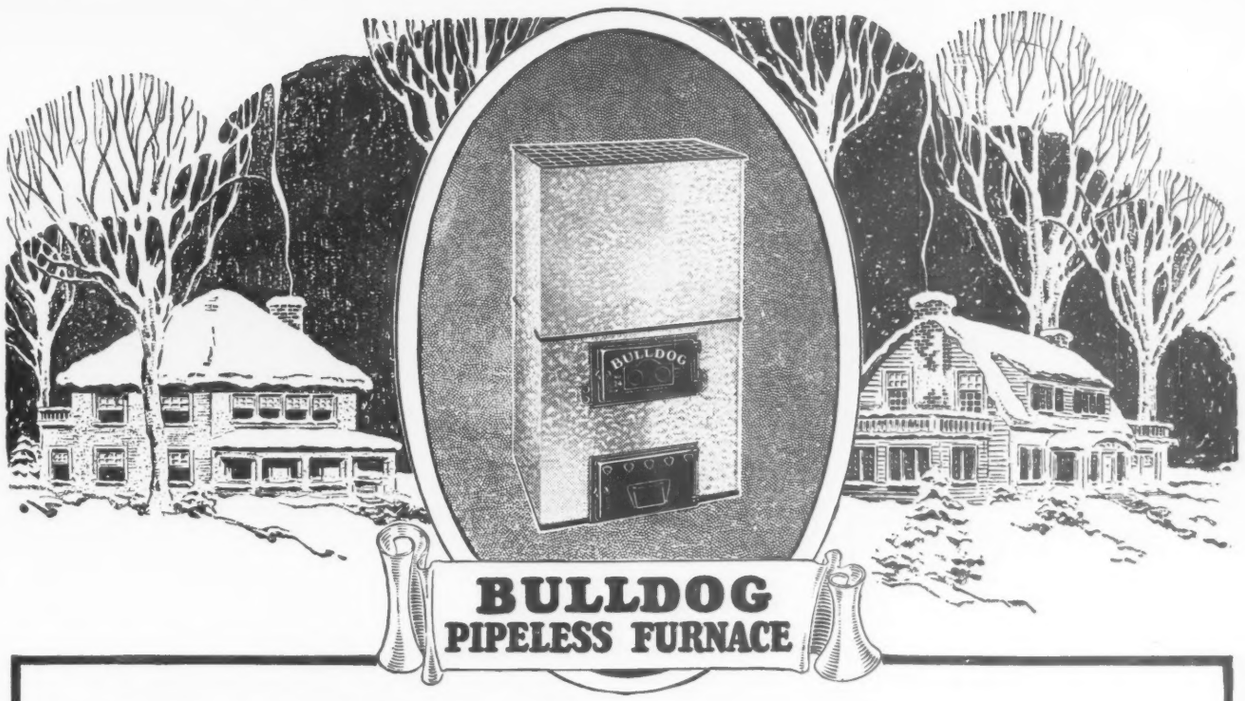
IF YOU wish to make your own paint for galvanized iron, use the best red oxide paste and thin with pure boiled linseed oil to the proper consistency. Brush this with as much care as if you were painting the house, and your roof will last for years.

When working on your roof, always fasten down all metalwork around the chimneys or dormers and be sure when painting valleys on a shingle roof to crowd the paint up under the edges of the shingles, as it is here that 90 per cent of the leaks in the valleys occur.

If copper valleys have been used, an agreeable color can be obtained by painting the metal with a solution of vinegar and salt water. This turns the copper a bright green, which contrasts beautifully with the duller slate or shingled surfaces.—C. W. HUBERTZ, Corry, Pa.

Polishing Furniture

PROFESSIONAL furniture finishers generally are agreed that lemon-oil polish is the most satisfactory for regular use. Another good polish that cannot harm the finest furniture is 1 pt. neutral oil and 2 heaping teaspoons whiting mixed. Add 1 qt. water and shake well. By adding a generous quantity of rottenstone powder to this polish, it becomes an excellent abrasive for improving old, duster-scratched pianos.



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Half the Coal!

"I had a hot air furnace in our 7-room house before I got the Bulldog and our house was always cold. With the Bulldog it only takes *half as much coal* and we had weather below zero, and the house was nice and warm in the morning when we got up. We never have the draft on more than half an hour at a time, and it has the place red hot. It is easy to regulate and keeps the fire all day in mild weather.

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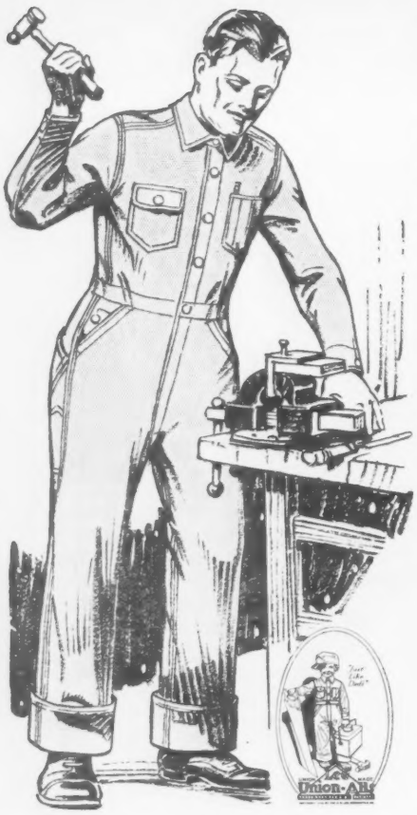

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The Home Workshop

Building a Tea Wagon Is a Fine Project for Leisure Hours

One of Many Things You Can Construct with the Aid of Home Workshop Blueprints

BEST results in building furniture, radio sets, workshop equipment, and the like for your home will come from following well worked out and fully detailed plans such as those contained in POPULAR SCIENCE MONTHLY'S series of blueprints.

If, for example, you wish to make a tea wagon such as the one illustrated, you can work without any definite plans, piecing the parts together as you go along and trusting to luck that the assembly will be good looking when finished, or you can make a working drawing of your own, which is a time-consuming and rather difficult undertaking for the average amateur woodworker, or you can obtain for 25 cents a blueprint with the complete drawings and a bill of materials showing the exact size of each part. Merely to state these alternatives is sufficient to indicate which is the easiest and the one most certain to produce satisfactory results.

A solid walnut tea wagon made for $20 by H. Caldwell from Home Workshop Blueprint No. 13

The truth is that the more experienced a mechanic is, the more certain is he to use a drawing to work from, whenever possible. Even if he wishes to change the size or shape or modify any of the details, he still wants to have a drawing that will serve as the basis for the main construction. It gives him the necessary starting point for his work.

If you have not yet taken advantage of this service, why not try one or more of the blueprints? It may aid you in making a selection if you know that the most popular blueprints have proved to be the tea wagon (No. 13), the sewing table (No. 1), the smoking cabinet (No. 2), the kitchen cabinet (No. 5), the workbench (No. 15), and the cedar chest (No. 17).

Unless you have a good bench and ample storage space for your tools, it will pay you to start by making the cabinet bench. Not only does it provide a working top of generous size and the most rigid construction, but it contains several convenient drawers and compartments for tools and materials.

Among the other blueprints mentioned there is little to choose, except that the sewing table is the simplest and the smoking cabinet offers the most opportunity for elaboration in the way of inlaying, carving, or painting.

In ordering any of these, please use the coupon below.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

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32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c

Name.....
(Please print)

Street.....

City and State.....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

Making Jelly for a Million Breakfast Tables

WHEREVER jellies and jams are made in huge copper kettles holding hundreds of pounds of bubbling, boiling fruit juices you will find *Tycos* Temperature Instruments being used to insure the uniform results essential to manufacturing food products on a large scale.

The day is past when manufacturers dare to trust to rule of thumb methods to determine when the seething mass in the copper kettles have reached the right temperature. Science, in the form of *Tycos* Instruments for Indicating, Recording and Controlling Temperatures is used by the preservers to make it possible for them to put *exactly* the same quality jellies and jams on a million breakfast tables from the Atlantic to the Pacific; from the Gulf to our northern boundries.

Home-made jellies and jams can be made clear and sparkling, of good color and firm enough to retain the shape of the mold if the housewife will take a leaf from the manufacturers note book of experience and use a *Tycos* Thermometer, especially designed for home jelly making.

MANUFACTURERS

Whether making steel or soup, paints or rubber goods, bread or perfumery, or any other products that go through heat treating processes in their manufacture, you need the Sixth Sense of Industry, *Tycos* Instruments for Indicating, Recording and Controlling Temperatures in your plant.

If your manufacturing problems require the indicating, recording or controlling of Temperature, there is a type and style of instrument in the *Tycos* Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. · · U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO

Tycos—for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Taylor Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Taylor Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

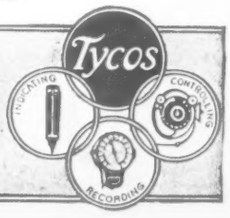
Tycos—for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING



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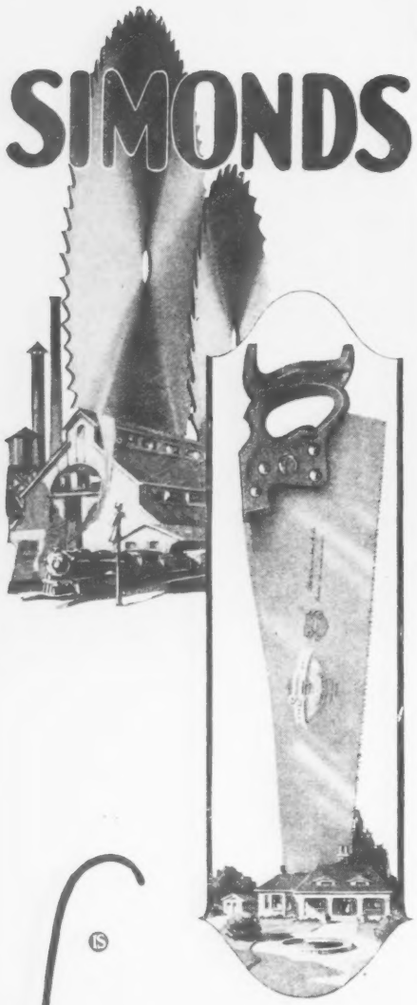
SIMONDS



from Saw Mill to Bungalow

—WHEREVER MEN DEPEND UPON CUTTING TOOLS MOST

Simonds Circular Saws are the favorites in the big mills. Simonds Hand Saws are first choice among skilled carpenters and other craftsmen. Both mills and craftsmen choose Simonds Saws because they want perfect cutting qualities in any saw they use. And they know that a Simonds Saw can only be produced by Simonds. They know, too, that a characteristic Simonds cutting edge is made possible only by using the specially processed steel, developed through nearly a century of experience. Ask your hardware or mill supply dealer for these saws or write us for catalog.

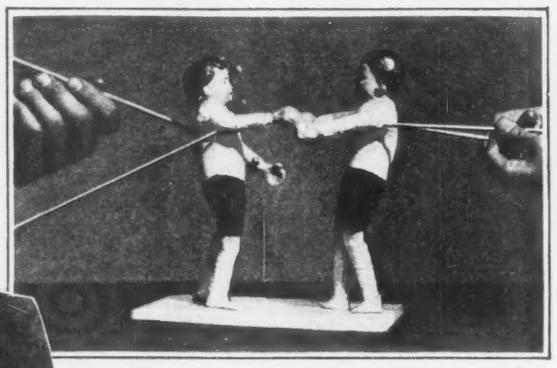
SIMONDS SAW & STEEL COMPANY
Fitchburg, Mass.
"The Saw Makers" *Established 1832*
Branch Stores and Service Shops in Principal Cities

SIMONDS
Pronounced SI-MONDS
SAWS FILES KNIVES STEEL

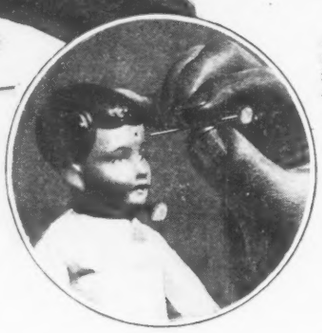
The Home Workshop

Unique Boxing Doll Game

Contestants "Fight" by Manipulating Small Figures



A pair of boxing dolls ready for a battle. Their arms are controlled by the contestants, who put them through the motion of fighting and endeavor to punch in the pins



At left—Dressing a papier-mâché doll in trunks and inserting one of the markers which are designed to register blows

TWO papier-mâché dolls, four pieces of wire, some nails and putty and cloth, all not costing more than 40 cents, can be made into an amusing boxing game.

The arms of the dolls are operated by the two contestants. Each tries to win a "knock-out" by manipulating his boxer so that it punches in each of the three buttons exhibited by the opposing doll pugilist.

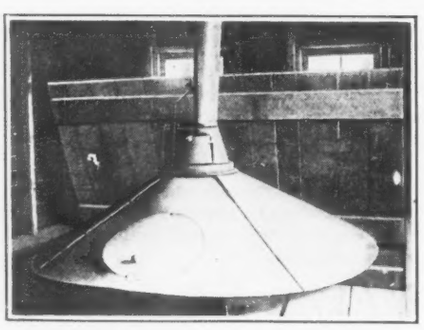
The dolls, as purchased from the variety store for 15 cents each, are dressed in white tights and black trunks. Nails with putty buttons molded on the heads serve as the targets and indicators. Large glass-headed pins, if cut short, will serve as well. The lowest of the three photographs shows one of the targets about to be inserted in a boxer's forehead. The gloves are made of putty and molded on the boxers' fists;

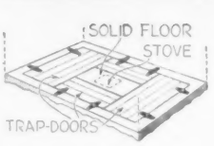
Practice and quickness of hand and eye are necessary to "down" the opposing boxing doll by punching home the three little buttons.— KENNETH B. MURRAY.

Those who have been following Edward E. de Lancey's series of model-making articles will be sorry to know that illness has delayed temporarily the preparation of the concluding article.

To Keep Rats from Brooder House

BROWN rats, which destroy a disheartening number of small chicks every season, make their nests under the wooden floors of brooder houses. To keep the rats out, a satisfactory method is to remove the floor, being careful not to damage the boards, and remake it in sections similar to batten doors.





A brooder house, showing raised section of floor and diagram of typical arrangement of hinged flooring

If the building is small, one door or section on each side will be sufficient; if large, make one for each side and end, leaving that part occupied by the brooder stove solidly nailed to the floor timbers.

Nail one board securely at each side and end of the building and hinge the various sections to these border pieces. The sections then can be raised instantly and rats routed out and their nests destroyed.

Another advantage of having the floor in sections is that when the house is not in use, they can be raised, thus keeping the ground dry and thereby preventing the decay of the foundation timbers and the floor. The cost need not be more than the price of the hinges required, a little lumber, and a few nails. The work itself can be done in spare time. —J. R. KOONTZ, Bremen, Ind.

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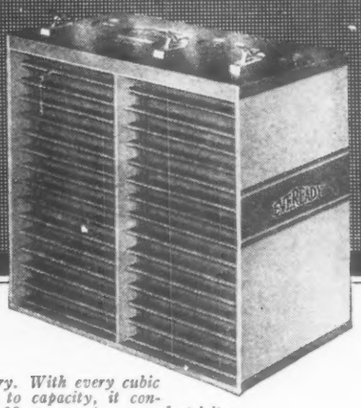
NEW! *Radically different!*

No. 486 Eveready Layerbilt "B" Battery. 45 volts. Length, 8 3/16 inches. Width, 4 7/16 inches. Height, 7 3/16 inches. Weight, 14¼ pounds. Price, $5.50.



It's all battery. With every cubic inch packed to capacity, it contains about 30 per cent more electricity-producing material. All chance of loose or broken connections avoided by contact of full area of carbon plate against zinc plate. The scientifically correct construction.

The greatest improvement ever made in "B" Batteries

ABSOLUTELY new in construction—perfected through years of research, the new Eveready Layerbilt "B" Battery is as superior to the old type "B" Battery as a tube set is to a crystal.

Heretofore, all dry "B" Batteries have been made up of cylindrical cells—no one knew how to make them any other way. The new Eveready Layerbilt is made of *flat* layers of current-producing elements compressed one against another, so that every cubic inch inside the battery case is completely filled with electricity-producing material. Layer-building heightens efficiency by increasing the area of zinc plate and the quantity of active chemicals to which the plate is exposed.

After the most rigid laboratory tests, more than 30,000 of these new Eveready Layerbilt "B" Batteries were manufactured and tested by use under actual home-receiving conditions. These tests proved that this new battery is far superior to the famous Eveready Heavy-duty Battery No. 770, which up to now we have ranked as the longest lived "B" Battery obtainable.

On 4-tube sets, 16 mil drain, it lasts 35% longer.
On 5-tube sets, 20 mil drain, it lasts 38% longer.
On 6-tube sets, 24 mil drain, it lasts 41% longer.
On 8-tube sets, 30 mil drain, it lasts 52% longer.

The new Layerbilt principle is such an enormous stride forward in radio battery economy that we will bring out new sizes and numbers in this Layerbilt form as fast as new machinery is installed. For the present, only the extra-large 45-volt size will be available.

Buy this new Eveready Layerbilt No. 486 for heavy drain service. It far exceeds the performance for which Eveready Radio Batteries always have been famous and is, we believe, by far the most economical source of "B" current obtainable.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR EVERY TUESDAY *at* 8 P.M.
Eastern Standard Time
Beginning Sept. 29th, 9 P. M. *Eastern Standard Time*
For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

WEAF	New York	WGR	Buffalo	WWJ	Detroit
WJAR	Providence	WCAE	Pittsburgh	WCCO	Minneapolis
WEEI	Boston	WEAR	Cleveland		St. Paul
WFI	Philadelphia	WSAI	Cincinnati	WOC	Davenport

Ⓘ

EVEREADY
Radio Batteries
—they last longer

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

Your Hammer

If you're particular about your tools

When you grip a Maydole you feel as if it was made specially for you.

No other hammer has its marvelous "hang". It's the result of eighty-two years of painstaking development.

And the Maydole has a strength and stamina that's worthy of its design. The head is of press-forged steel, tempered separately at each end for the particular work it is to perform. The handle of clear second-growth hickory, air-dried for years. It's made tight and it stays tight.

For real hammer service and satisfaction, make sure that "D. Maydole" is stamped on the head of every hammer you buy, whether it's a nail hammer, machinists' or any other type of hammer.

Your dealer will gladly show you the Maydole you need.

Write for free pocket handbook 23 "B".

THE DAVID MAYDOLE HAMMER CO.
Norwich, New York

Maydole Hammers

7871
BE YOUR HAMMER SINCE 1843

The Home Workshop

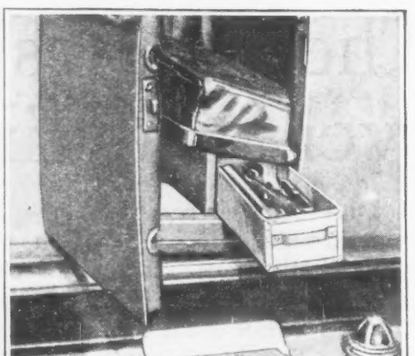
Handy Toolbox for Your Car

By H. T. Shrum

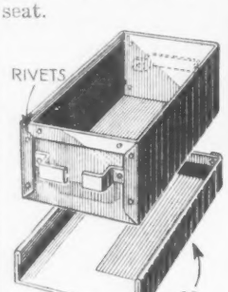
Instructor of Auto Mechanics
State Normal School, Oshkosh, Wis.

ANY one who has toured the country much and has taken care of his car, doing the oiling and minor repairs himself, will appreciate the toolbox arrangement illustrated, especially if it is possible to install a similar one in his own machine.

For two years the writer had a small sheet-metal box in which the most used tools were kept. So that it would be handy for changing a tire or to make some slight repair, it was kept on the floor board just under the edge of the front seat. When the spare tire was needed, all tools including the jack were available and it was not necessary for the occupant of the other front seat to move in order to get at the tool compartment under the seat.



Simply made sheet-metal toolbox that slides under the front seat of an automobile



How the toolbox and slide are made

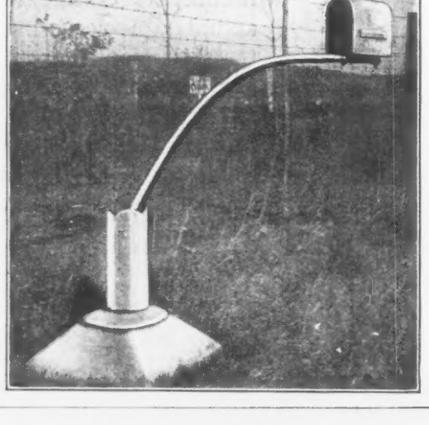
There were times, however, when the open tool box was in the way or the tools seemed unduly exposed to strangers when the car was parked. For these reasons a box was made to slide under the front seat, after the block which closed up this space had been removed.

The box dimensions, of course, depend upon the opening available. In this case the box is 4 in. deep, 5¾ in. wide and long enough to receive the jack handle, or 14 in.

The box is constructed very simply of 28-gage galvanized iron, bent up at the bottom and end corners and well riveted. A 3/16-in. strip or "hem" is folded over to strengthen and finish the top edge. A handle on each end is provided so that the box may be carried to the work after it has been withdrawn from the slide.

The slide is built much like a box lid, open at one end and with a hem turned on the edges to finish and strengthen them. It is riveted at the corners and then screwed or tacked in place to guide the box under the seat and keep it in place. The tools may be kept from rattling by lining the box with carpet.

Mailbox Supported by a Swinging Arm



RURAL mailboxes that can be swung to the side of the road have three advantages: They can be turned out of the way when the highway is being graded, they are not apt to be broken off by the passing of an extra large load of hay or grain, and in snowdrift time they can be swung to the most accessible point of approach.

The support illustrated is made of a piece of 6-in. well casing 2 ft. long, with three circular notches in one end to serve as seats for the swinging arm. The casing is set in a concrete base with the bottom end open to allow for drainage. The arm is 1¼-in. well pipe, flattened where the box is bolted on and screwed at the bottom into a discarded well cylinder, which is filled with concrete as a weight.—A. C.

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You may escape the collection ~ but not the need of OZARKA SERVICE

THE satisfaction you receive from your radio depends not on what it does once in a while—but night after night and month after month. Whether you grin or cuss depends on the service behind your radio.

Ozarka radio instruments are *only* sold by trained factory representatives, men who not only specialize in radio but sell and service Ozarkas only. 3,100 of these men, trained directly under Ozarka engineers constitute a service force, unequalled elsewhere in radio today.

When you buy a radio you'll compare appearance, tone, volume and selectivity by having various instruments set up in your own home but—that isn't enough—compare the service behind each one.

Any Ozarka factory representative will set up an Ozarka in your home—he will not even operate it himself, but depend for his sale on what you yourself do. If you, by your own operating, do not bring in the distance, the volume and tone, you expect a radio to give, then do not buy the Ozarka. If you do buy it, you can rest assured, no matter what happens, a competent service man is at your call at all times. No Ozarka representative can sell Ozarka Instruments without giving Ozarka service. You are entitled to such service—demand it!

The Ozarka Representative knows every part, every wire of the Ozarka. In fact he completely assembles his own instruments. His training on installations, aerials, ground connections, operation and service comes directly under our own engineers who designed and perfected the Ozarka circuit.

That is why our book, "Ozarka Instruments No. 200," describing all models of Ozarka should be of particular interest to you. This book and the name of the Ozarka representative near you will be sent immediately at your request. Please give the name of your county.

We Have Openings for a Few More Ozarka Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman—our present president, the Ozarka organization has grown to over 3100 people. There must be some good reason for this growth.

Ozarka instruments have made good—they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Check Coupon for FREE Selling Book

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach the coupon. If interested in our salesman's plan ask for "Ozarka Plan No 120 R.

OZARKA
120 Austin Avenue R
Chicago, Illinois

INCORPORATED
120 Austin Avenue R
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 120 R" and name of Ozarka representative.

Name.....

Address.....City.....

County.....State.....

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

Name.....

Address.....City.....

County.....State.....

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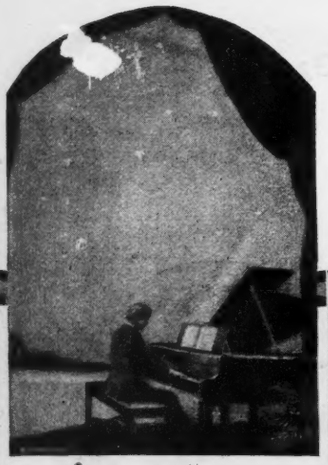
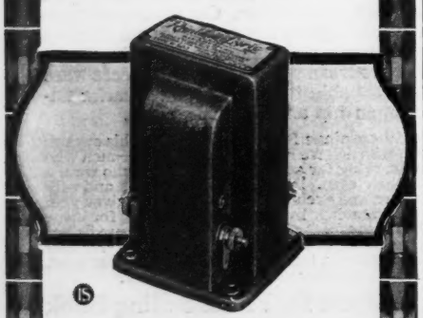


A Nocturne Played to the Pensive Night

Softly the shadows overtake the day. Comes dusk, then evening. Celestial torches shed their faery light as a dreamy melody sings to the night and to the stars. An artist, in meditative mood, plays in your very living-room. Such is the joy that Radio brings—perfect if Rauland-Lyric is used to amplify, for this instrument transmits with utmost fidelity every detail of the rendition.



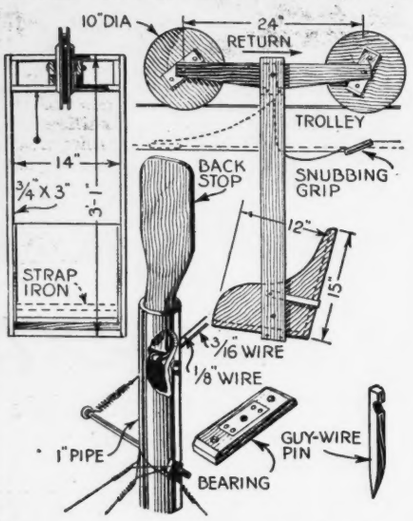
Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 4201 Belmont Ave., Chicago.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER
The Choice of Noted Music Critics

The Home Workshop

A Back-Yard Air-Coaster for Small Children

AT LITTLE cost it is possible to build a simple air-coaster that will furnish safe and thrilling sport for children. Two posts of 1-in. pipe are set up as far apart as possible, preferably about 50 ft., one projecting about 5 ft. above the ground and the other 3 ft. 6 in. These are guyed with wire and a 3/16-in. wire is stretched between them at the top. On this runs the car, which is made as detailed.



Front and side views of the aerial car and the top of one of the posts

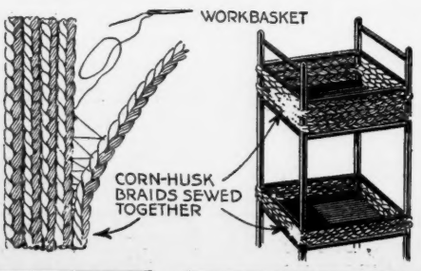
While the car can be pushed back to the high end of the line after each trip, it is more fun if a more mechanical method of return is provided. A good way to do this is to fasten a wooden tube, such as a package-carrying handle, to the car by means of a chain or heavy cord and run through it a length of 1/8-in. wire. This wire should be fastened to each post by means of an extension bolt and a spring should be placed at one or both ends.

By using the wooden handle it is possible to obtain a snubbing grip on the 1/8-in. wire so that the rider can pull himself back easily with his right hand. The grip also serves as a brake on the downward trip. The details of the construction are illustrated fully at the left.—DONALD W. CLARK.

Mats and Baskets Made of Corn Husks

MATS of great durability, as well as sewing stands and ornamental baskets, can be made from corn husks.

Let the husks from several dozen roasting ears or ears of field corn dry until the green color is out of them. They should not be so dry, however, as to break when bent. If too dry or old, they should be scalded with hot water and used while still slightly damp.

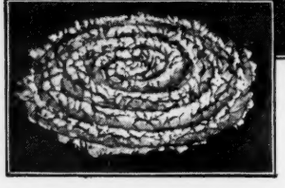


Six steps in making the preliminary braid of common, dried corn husks

Take three small bunches of the husks, tie them together 2 or 3 in. from the large end and start braiding them, preferably in a three-strand braid. Add a new bunch whenever an end becomes too short, placing it right on top of the short end. This will be about every other fold on short husks. Let the heavy end stick out above the work about 2 in. each time.

For an ordinary door mat a braid about 16 ft. long is necessary. To complete the mat it is necessary merely to coil the strand up to make a circle, oval, or rectangle, as desired, sewing the turns together with strong thread and a large needle. For a square mat, it is a good plan to carry the

(*Continued on page 106*)



The braids are sewed together to form baskets or floor mats

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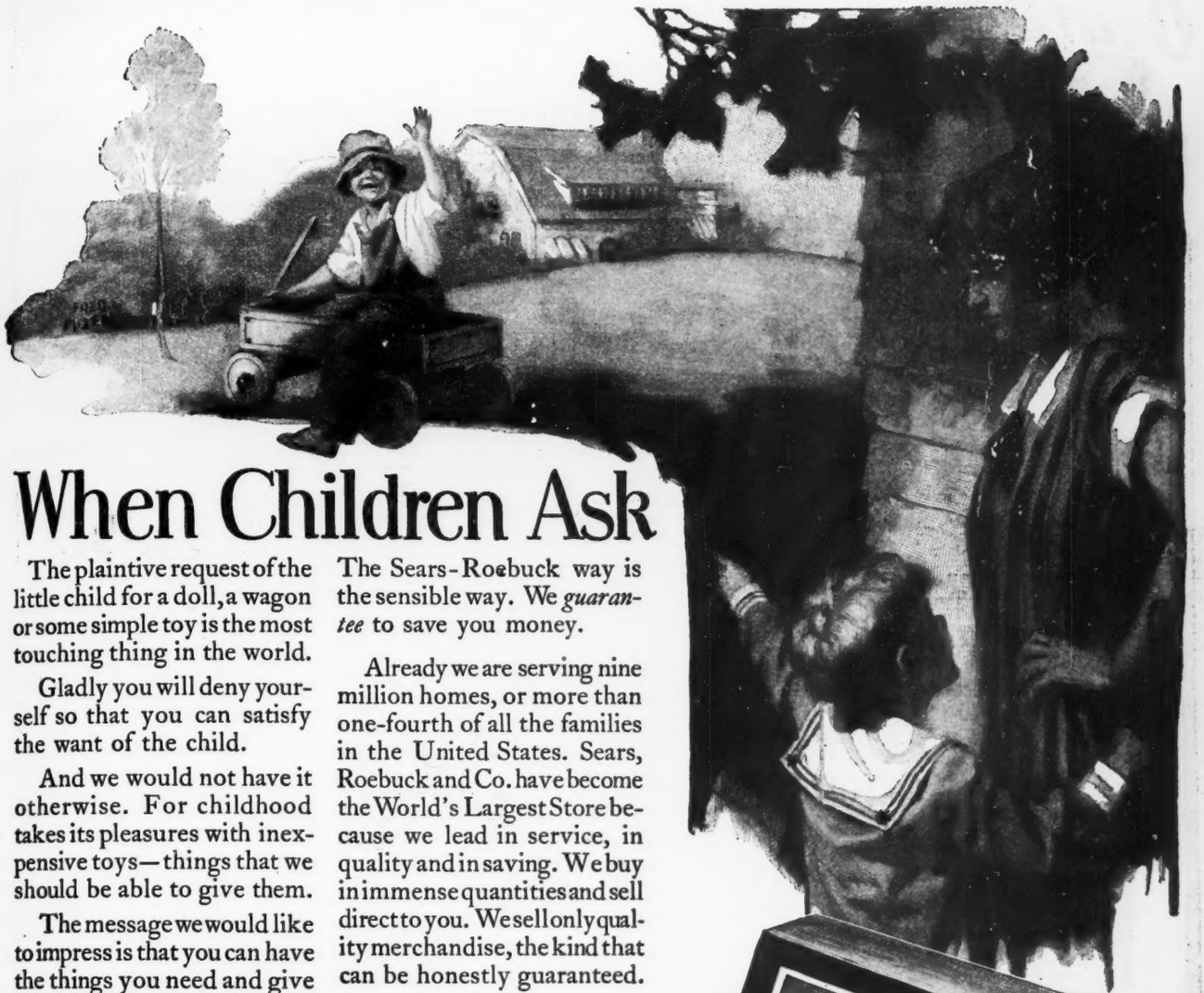


When Children Ask

The plaintive request of the little child for a doll, a wagon or some simple toy is the most touching thing in the world.

Gladly you will deny yourself so that you can satisfy the want of the child.

And we would not have it otherwise. For childhood takes its pleasures with inexpensive toys—things that we should be able to give them.

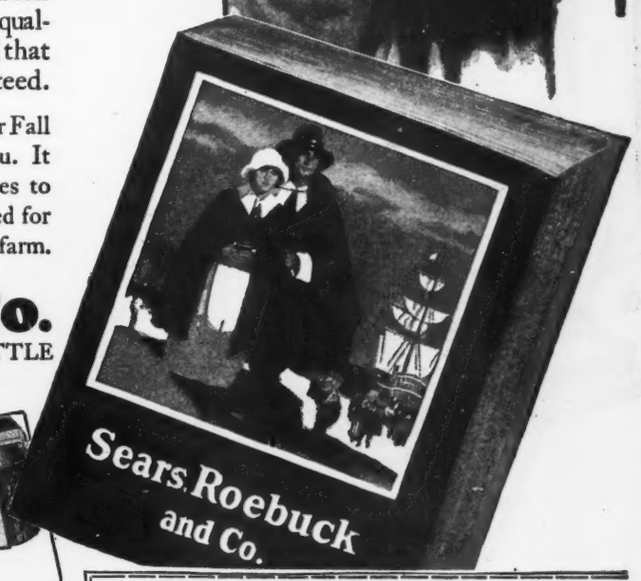
The message we would like to impress is that you can have the things you need and give your children the things they would like. The way is easy.

It is only necessary to buy right. "Thrift is common sense applied to spending."

The Sears-Roebuck way is the sensible way. We *guarantee* to save you money.

Already we are serving nine million homes, or more than one-fourth of all the families in the United States. Sears, Roebuck and Co. have become the World's Largest Store because we lead in service, in quality and in saving. We buy in immense quantities and sell direct to you. We sell only quality merchandise, the kind that can be honestly guaranteed.

Our New Big Catalog for Fall and Winter is ready for you. It shows 35,000 opportunities to save on everything you need for the family, the home and the farm.



Sears, Roebuck and Co.

CHICAGO . PHILADELPHIA . DALLAS . SEATTLE

Send for Your FREE Copy

If you haven't a copy of our New Big General Catalog, send for it today. This convenient coupon will bring you free our great Fall and Winter book, with its 35,000 bargains.

WORLD'S LARGEST STORE

We own and operate Radio Station W L S. Tune in on 344.6 meters.

Mail the coupon TODAY to the store nearest you

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Chicago Philadelphia Dallas Seattle 91P82

Send Latest General Catalog.

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Only $4.90 for—

A Selected Set

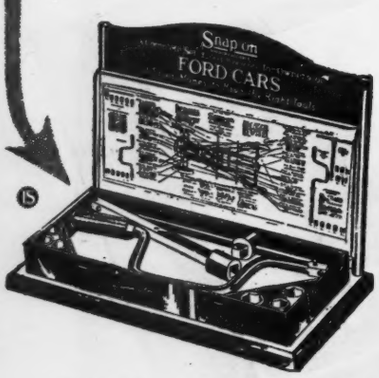
Snap-on

INTERCHANGEABLE
SOCKET WRENCHES

With Which You Can Repair Your Ford In Garage Style

Be ready to fix it quickly in cases of emergency on the road—save repair bills—make your car run better and last longer. It is an easy matter to reach and turn the nuts and bolts throughout the Ford car with this remarkable Snap-On Set. There is a special chart which shows the inexperienced owner all of the most important repair jobs.

No need for you to be at the mercy of ordinary, inefficient tools when you can get the Genuine Snap-Ons for so little money. Snap-Ons will pay for themselves a hundred times over.



What Car Do You Drive?

There is a special Snap-On Set, equally as good for each different make of car. Any Snap-On dealer is an expert on the tool needs for your car. He can be of real service to you.

Snap-On Wrench Company, Mfrs., Milwaukee

Look for the name Snap-On on each handle and socket. It is not a genuine Snap-On without the name.

Motor Tool Specialty Co., 14 E. Jackson Blvd., CHICAGO

Gentlemen:

Please send me full particulars about Snap-On Set for ----------car. (If interested in Master Mechanic's Set, check here----------)

I buy tools from----------

Name----------

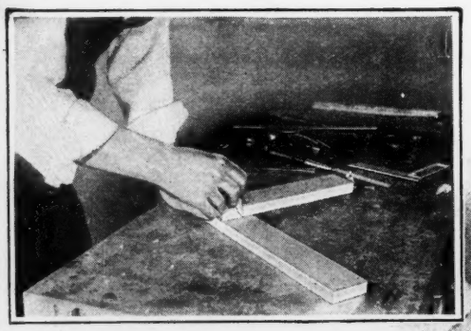
Address----------

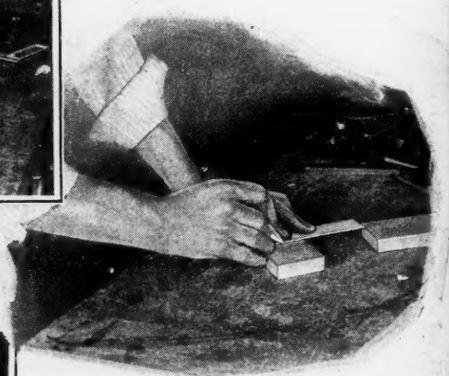
The Home Workshop

Preparing an End-Lap Joint

By Emanuel E. Ericson

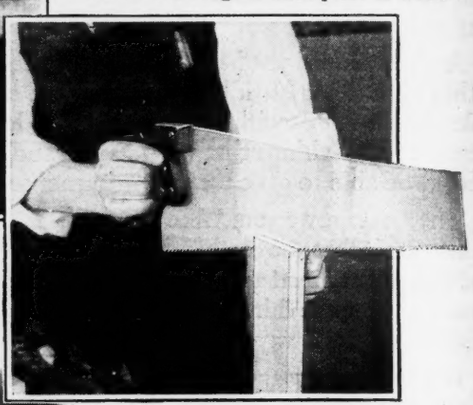
Noted Manual-Training Authority





1 Lay one piece in the correct relative position on the other and mark the lower with the point of a knife. Turn the parts over and mark the other piece

2 Using your try-square and being guided by the marks you have just made, draw knife lines across one broad surface and about one-half the distance across each edge of each piece of wood



3 Set your gage for approximately one-half the thickness of the wood and mark both pieces, in each case marking from the upper surface or working face

4 Cut on the gaged lines with a ripsaw, keeping on the side of the lines that is in the waste part of the wood

5 The cross cuts necessary to remove the waste wood can be made most easily with a backsaw. A wooden bench hook—a board with a block screwed on top of one end and beneath the other—is convenient for holding the stock. The wood also can be held in the vise and cut with a fine hand-saw

6 If carefully made, the joint will fit without chiseling and both sides will be even, provided the pieces are of the same thickness. The joint may be fastened with glue and screws, or nailed. It forms a simple yet strong connection

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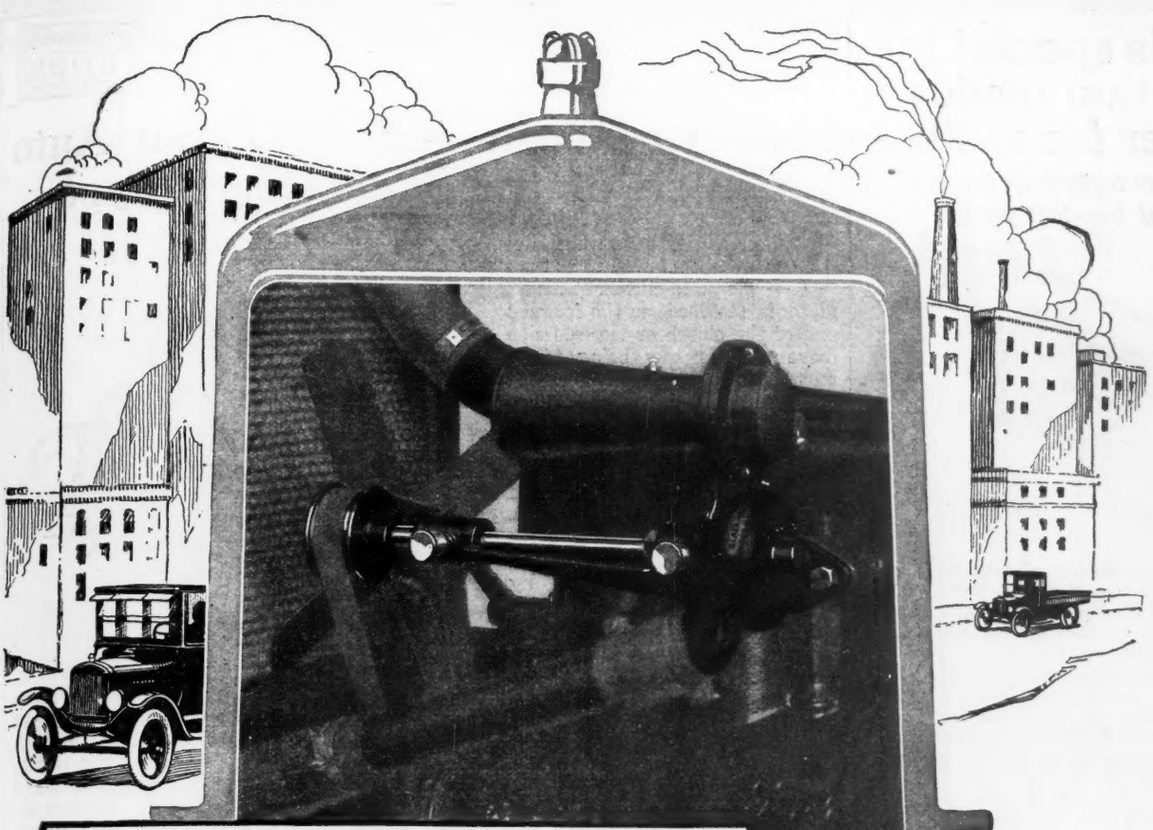

Pumps Longer Life Into Your Ford

OVERHEATING junks more Fords than long service does. A boiling radiator is a danger signal. It means a power-sapped motor and thinned oil that leads to scored cylinders, burned-out bearings, and the scrap heap. Protect your sturdy little car with a Blackhawk Water Pump. It will keep your motor at the right heat for peak power and longest life.

The Blackhawk "Chief" outpumps all others because of its turbine-type impeller. Other features are its double bronze bearings with double grease lubricators, flanged drive pulley, and extra-husky construction.

A Blackhawk Pump is all-year protection. Ends boiling in summer, and prevents freezing in winter by briskly circulating the water and stopping evaporation of alcohol.

Your dealer can supply you with the "Chief" at $7.50 (Western price $8.00). Or write us direct.

BLACKHAWK MANUFACTURING COMPANY
(Formerly American Grinder Mfg. Co.)
DEPARTMENT L MILWAUKEE, WIS.

Turbine Head
This exclusive Blackhawk turbine-type impeller *delivers more water* at all speeds.

The Scout
Here is the best pump at its price on the market. Second only to the "Chief" in pumping power and has many of its features. Only $5.00 (Western list, $5.50). Both pumps come complete with belt and horn bracket.

Flanged Crankshaft Pulley
Keeps your Ford fan belt always on the job. Interchangeable with old pulley. All steel and sturdy.

Only 75c

BLACKHAWK

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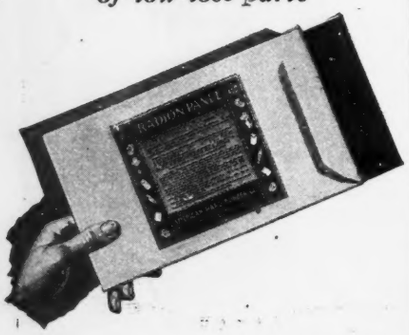
This special insulation made to order for radio—

Now built into a line of low-loss parts



The first choice of thousands of successful set builders is Radion Panels —made of *Radion*, the insulating material built to order by our engineers for radio exclusively.

Now we announce new developments in *radio parts* made of this perfect insulation that practically reduces losses in reception to a minimum.

These parts have the wonderful Radion finish, smooth and high-polished. This finish eliminates those losses caused by moisture gathering on the surface of ordinary insulation, causing leakage paths. The high-resistant characteristics found only in Radion Panels also mark these new parts.

You can now get Radion Sockets, Radion Dials, the new Radion Loud Speaker Horn, Radion Tubing, Radion Binding Post Strips, Insulators, etc. And, of course, Radion Panels (made in black and Mahoganite) come cut in standard sizes for whatever set you wish to build. Ask your dealer to show you Radion Panels and the new Radion parts.

Send for Booklet "Building Your Own Set"

It gives wiring diagrams, front and rear views, shows new set with slanting panel, sets with the new Radion Built-in Horn, list of parts and directions for building popular circuits. Send coupon with 10 cents for your copy. AMERICAN HARD RUBBER COMPANY, Dept. F-6, 11 Mercer St., New York City. Chicago Office: Conway Building. Pacific Coast Agent: Goodyear Rubber Co., San Francisco —Portland.

New No. 10 4-inch Radion Close-Tuning Dial, built to conform to the fingers.

RADION

Ⓑ *The Supreme Insulation*

AMERICAN HARD RUBBER COMPANY
Dept. F-6, 11 Mercer St., New York City.

Please send me your booklet, "Building Your Own Set", for which I enclose 10 cents in stamps.

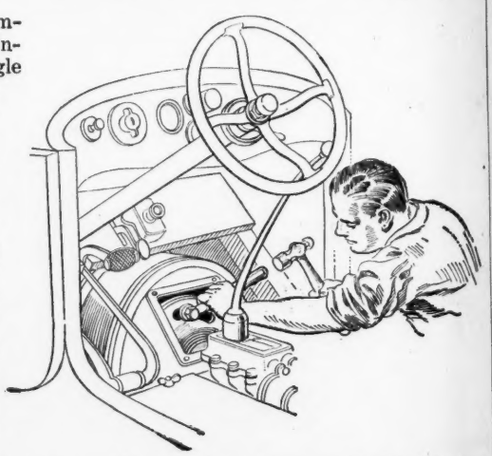
Name .....

Address .....

.....

The Home Workshop

How to Repair and Adjust an Auto Clutch of the Single-Plate Type

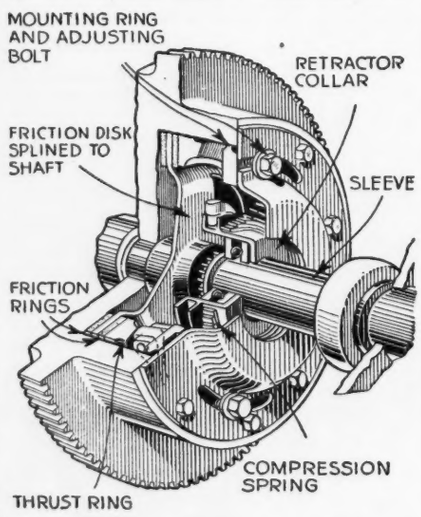


MANY cars have what is commonly referred to as the single-plate clutch. This single plate is fastened on the forward end of the clutch or transmission drive shaft, power being transmitted to it from the flywheel. It rides between two friction surfaces or clutch facings.

While similar in action and handling to the multiple-disk clutch, the care and adjustment of this clutch are not quite the same. The multiple-disk clutch in some instances is not adjustable and in other cases is adjustable by putting it under the arbor press and pressing the end driving plate down, after which a split collar is moved forward a notch. In other cases the multiple disk clutch is adjusted by taking up on three or more bolts, which compress the clutch springs.

The single-plate clutch is adjusted by loosening two setscrews to be found on the clutch cover, which is bolted to the flywheel. The two adjusting screws are easily recognized, since they are set in slots. When the screws have been loosened and the clutch has been disengaged by depressing the foot lever and the adjusting ring inside, the clutch is moved ½ in. around to the right or clockwise by tapping either one of the setscrews. After moving them this amount, they are locked in position.

If the clutch previously has been adjusted until no further slot motion is possible, it will be found in most cases that new holes for the setscrews have appeared within the slots. A time finally comes, however, when it is no longer possible to adjust the clutch, and, unless the slipping is due to glazed friction rings, the job will have to be dismantled and new friction disks or rings installed.



Cutaway view of flywheel and single-plate clutch showing friction rings and adjusting bolts

It sometimes happens that the friction rings allow the clutch to grab or slip, yet are otherwise in good condition. In such cases it is well to wash out the clutch. Remove one of the adjusting screws and pour in ½ pt. of kerosene. Replace the adjusting screw and start the motor. Allow the motor to run slowly from 10 to 15 minutes, working the clutch in and out as the motor runs.

Drive the car on a steep grade or blocks so as to raise the front of it higher than the rear. Turn the flywheel until the adjusting screw is on top, remove it and turn the hole down so that the oil may drain out. If possible, allow the car to rest in that position overnight.

If it is found that the clutch still grabs, a small amount of lubricating oil may be squirted on the plate and friction disks. Use just enough to moisten the friction disks. The latter method of treating a clutch may be used to relieve grabbing when it is not possible to wash it out thoroughly.

If it is found necessary to reline the clutch, which in this case is merely installing the new clutch friction disks—they are not fastened as are the multiple-disk clutch facings—the first step is pulling the transmission. The method of proceeding in this work was outlined in an article on relining clutch disks in the May issue of POPULAR SCIENCE MONTHLY (page 92).

When the transmission is pulled the clutch is left in the flywheel. To facilitate the work a block about 1⅜ in. high and 4 in. long is used to block out the throw-out yoke. After the cap screws holding the clutch assembly to the flywheel have been removed, the clutch assembly will come away easily. Before removing it, however, prick punch some identification marks on the cover and flywheel to insure proper reassembly.

In all clutch disassembly and reassembly work the most difficult part is compressing the spring. Facilities at hand will determine the method to be used. The

(*Continued on page 108*)

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The covered wagon has gone; like the old-fashioned charger with the slow 2-ampere rate it is obsolete!

Buy nothing but an up-to-date 5-ampere charger!

The New Improved

5 AMP. A & B GOLD SEAL HOMCHARGER

$19.50

Over 500,000 already in use

Get This Modern Fast Charger!

Better Because:—

New micrometer adjustment, hinged lid, and carrying handle.

No bulbs to buy or break.

Can be used anywhere—contains no acids or other harmful liquids to spill.

Approved by underwriters—trouble-proof, shock-proof and fireproof.

Beautiful cabinet in maroon and gold.

Free *Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."*

When you buy a charger don't let anybody sell you an obsolete, slow 2-ampere model.

The New Improved GOLD SEAL HOMCHARGER, with its full 5-ampere rate, charges your battery overnight! Does away with the long bothersome waits that were necessary when the slow inefficient chargers of last year were the best that radio offered.

And the New Improved GOLD SEAL HOMCHARGER charges both A and B batteries without additional equipment.

Be sure when you buy that you get a modern, fast charger, with a 5-ampere rate. To be *absolutely sure*, insist on the GOLD SEAL HOMCHARGER.

The Kodel Radio Corporation

500 East Pearl Street · Cincinnati, Ohio

WKRC

Owners of Kodel Broadcasting Station WKRC on the Alms Hotel. Send for program.

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"ATKINS"
Always Means Quicker, Easier Metal Cutting!

YOU—whenever and wherever you cut metal—can save time and money by using genuine Atkins "Tungsten Alloy" Hack Saw Blades.

The Atkins Hack Saw Chart—free—tells the right Atkins blade for every metal cutting job, to save you time, money and material.

The name ATKINS on the blade means the highest grade "Tungsten Alloy" steels chosen by the great Atkins laboratories, tempered by the exclusive Atkins gas and oil process, "file tested" to prevent breakage and insure extra life and value.

Ask YOUR Hardware Dealer for genuine ATKINS "Tungsten Alloy AAA" Hack Saw Blades, "All Hard" or "Non-Breakable." We'll gladly send you the Atkins Hack Saw Chart and our valuable booklet "Atkins Saws In The Shop."

E. C. ATKINS & CO.
Established 1857
Leading Manufacturers of Saws, Saw Tools, Saw Specialties and Machine Knives.
INDIANAPOLIS, U. S. A.

ATKINS TUNGSTEN ALLOY SAWS

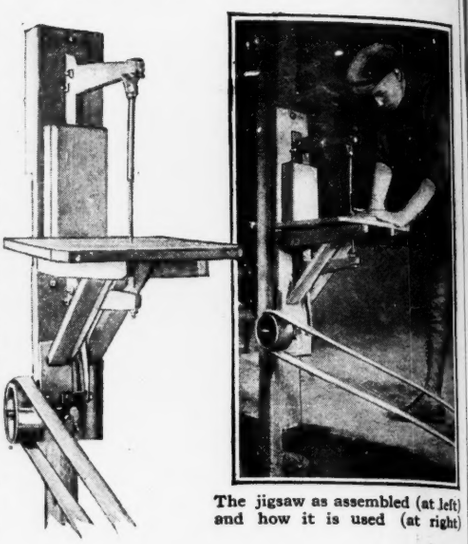
The Home Workshop

A Simple Jigsaw Driven by Power

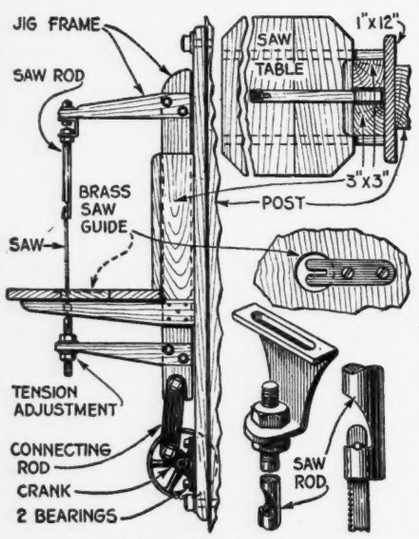
WHILE making a wooden pattern recently I found a jigsaw was indispensable, so I built the saw illustrated. Only after having put it to use did I realize how much time such a machine will save in a small shop.

The jig frame or saw carrier is built of straight-grained hard wood bolted together. It can move up and down between vertical guides in the main frame. The main frame, which is designed to be attached to any convenient post, carries a table; this should be about 2 ft. square, supported on brackets exactly at right angles to the back board and, if necessary, reinforced with braces underneath, as shown in the photographs.

A short piece of shafting with a crank at one end and a pulley at the other runs in two bearings fastened at the lower end of the back board.



The jigsaw as assembled (at left) and how it is used (at right)



Side view of machine, plan of saw table, and details of saw guide and fastenings

A short connecting rod connects the crank with the jig frame.

A small strip of brass is embedded in the table top to act as a guide for the saw blade. It prevents the saw from bending and breaking if the work is pushed against the blade too violently.

At the upper end of the jig frame is fastened a heavy piece of sheet metal cut and bent as shown in detail. The slot in this piece allows the saw blade to be adjusted so that it will be perpendicular with the table. To this metal bracket and to the lower arm of the jig frame are bolted threaded rods, each one being cut with a hacksaw, as shown, to receive and hold the end of the saw blade. An ordinary heavy coping-saw blade is used.

The table top should be sandpapered and varnished or oiled so that the work will slide freely, and the remainder of the machine should be painted. The pulley may be belted to a small electric motor or to any convenient source of power that will run the saw at a high speed.
—JONAS J. BYBERG.

How to Steam or Boil Long Strips of Wood

HOW to steam or boil long strips of wood to get them into condition for bending is sometimes a puzzling problem. One simple solution is illustrated.

From a junkman obtain an old steam boiler tube or even a galvanized-iron rainwater conductor pipe, which will answer well enough if the seams and joints are water-tight. Close one end with a round wooden plug. Stand this end in a shallow hole in the ground and pack the earth around it firmly enough to hold it upright. Put a little water in the pipe if the strips are to be steamed; fill it, if they are to be boiled. Insert the wood, place a flat stone on top of the tube, and build a fire around the base. There will be no danger of an explosion, as a small amount of pressure will raise the stone on top.—JAMES E. NOBLE, Toronto, Can.

Steaming strips of wood that are to be bent

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Balkite Radio Power Units

the ideal power supply for any radio set

FOR THE "A" CIRCUIT

U. S. Patent May 27, 1924

The Balkite Battery Charger

The most popular battery charger on the market. It can be used while the radio set is in operation. If the battery should be low you merely turn on the charger and operate the set. Charging rate 2.5 amperes. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $19.50

West of Rockies, $20

Slightly higher in Canada

U. S. Patent May 27, 1924

The Balkite Trickle Charger

Charges both 4 and 6 volt radio "A" batteries at about .5 amperes. Usable in 3 ways: (1) As a regular charger with a low capacity storage battery for sets now using dry cells. (2) With storage battery sets of few tubes. Furnishes more current than used by 6 dry cell or 3 storage battery tubes, so that if used during operation it need be used at no other time. (3) As a "trickle" or continuous charger for storage battery sets of as many as 8 tubes. Sizes 5½ in. long, 2¾ in. wide, 5 in. high. Operates from 110-120 AC 60 cycle current.

Low capacity batteries especially adapted for use with this charger are being offered by practically all leading battery manufacturers this fall.

Reputable manufacturers are also offering this fall for use with this charger special switches which turn on Balkite "B" and turn off the charger when you turn on your set. This makes the current supply for both "A" and "B" circuits automatic in operation.

Price $10

West of Rockies, $10.50

Slightly higher in Canada

Balkite Radio Power Units are the ideal power supply for any radio set. They simplify and improve radio reception. They reduce the amount of attention you must give your set. With their use your current supply is always exactly what is required for each circuit.

For the "A" circuit there are the Balkite Chargers. Because of its obvious advantages the Balkite Battery Charger is the most popular charger on the market. Entirely noiseless—it is the only charger commonly used while the set is in operation.

For sets of smaller "A" current requirements—any dry cell set or sets of few storage battery tubes—there is the Balkite Trickle Charger. With a low capacity storage battery it enables owners of sets now using dry cells to make a most economical installation.

For the "B" circuit there is Balkite "B"—the outstanding development in radio. It eliminates "B" batteries entirely and supplies plate current from the light socket. It fits any set of 5 tubes or less. For sets of six tubes or more there is Balkite "B" II, the same popular model offered last year.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are based on the same principle. All are entirely noiseless in operation. They have no moving parts, no bulbs, and nothing to adjust, break or get out of order. They cannot deteriorate through use or disuse—each is a permanent piece of equipment with nothing to replace. They require no other attention than the infrequent addition of water. They do not interfere with your set or your neighbor's. Their current consumption is remarkably low. They require no changes or additions to your set. They constitute the most advanced power equipment on the market, one that is economical, unfailing in operation, and eliminates the possibility of run-down batteries.

Manufactured by FANSTEEL PRODUCTS COMPANY, Inc.
North Chicago, Illinois

FANSTEEL

Balkite Radio Power Units

FOR THE "B" CIRCUIT

U. S. Patent May 27, 1924

Balkite "B"

Eliminates "B" batteries. Supplies plate current from the light socket. Operates with either storage battery or dry cell tubes. Keeps "B" circuit always operating at maximum efficiency, for with its use the plate current supply is never low. Requires no changes or additions to your set. No bulbs—nothing to replace. Requires no attention other than adding water about once a year.

A new model, designed to serve any set of 5 tubes or less. Size 8¼ in. long, 8 in. high, 3¼ in. wide. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current.

Price $35

Slightly higher in Canada

U. S. Patent May 27, 1924

Balkite "B" II

The most outstanding development in Radio last season. Same as the new Balkite "B" but will fit any set including those of 10 tubes or more. Current capacity 40 milliamperes at 90 volts. Size 9 in. high, 6¼ in. wide, 7⅛ in. deep. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $55

Slightly higher in Canada

The Unipower, manufactured by the Gould Storage Battery Company, is equipped with a special Balkite Radio Power Unit.

BALKITE BATTERY CHARGER · BALKITE TRICKLE CHARGER · BALKITE "B" · BALKITE "B" II

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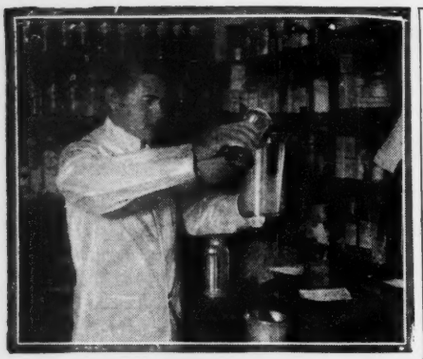

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PHARMACY
AT HOME

Graduate pharmacists are always in demand. The work is interesting and pleasant and salaries are good. Many young men open drug stores of their own and become independent.

There's an easy way to learn pharmacy right in your own home in spare time, without losing a day or a dollar from your present work.

The International Correspondence Schools course in Pharmacy supplies the knowledge which it will be necessary for you to have in order that you may pass your State Board Examination.

Just mark and mail the coupon printed below to the International Correspondence Schools, Box 7665-D, Scranton, Pa., and full particulars about the Pharmacy Course or any other work of your choice will be sent to you by return mail.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7665-D, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X

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☐ Architect
☐ Architects' Blue-prints
☐ Contractor and Builder
☐ Architectural Draftsman
☐ Concrete Builder
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Name.....
Street 3-6-24
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City.....State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

The Home Workshop

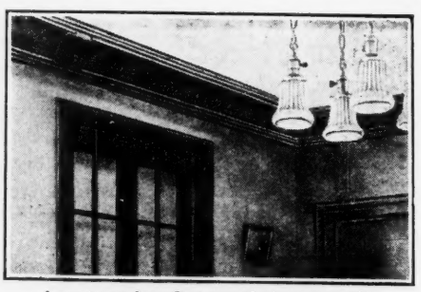
Easy Way to Build a Cornice

LIVING- and dining-rooms often are enhanced greatly by the addition of cove cornices. As ordinarily built, with the molding put up in single lengths, a high degree of skill is required to obtain good results, but by modifying the design to permit of splicing, the job may be simplified.

Figures given here are for the use of 8-in. cove molding made from rough stock 1½ by 8 in., but the principles of construction are the same for narrower molding.

Measure out from the wall plates 11 in. and strike lines by chalking a string, stretching it tightly between the given points and twanging it against the ceiling. Strike other lines 2½ in. from these running parallel to the ceiling joists, or about 8½ in. from the wall plates, and carefully remove the plaster between the lines and the walls by cutting and chipping out with a cold chisel. With a compass saw cut off the laths to the line.

Now cut a pine "two by four" 6 in. longer than the width of the room and slip it up through the opening thus made. Nail the ends to the plates with the crown edge up and then nail to it all the loose lath ends. If the backing joist in the corner can be removed, it will serve in place of a new piece. The purpose of this joist is to offer support for the upper member and cove of the cornice.



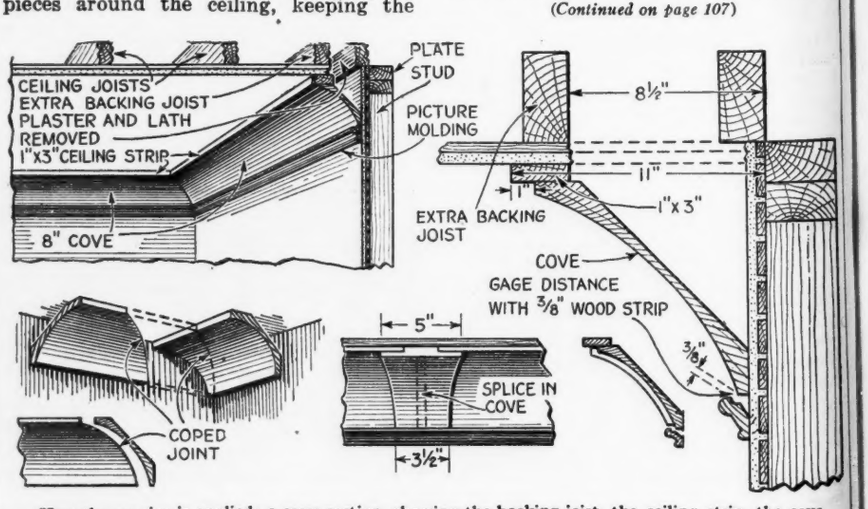
A neat cornice often greatly improves the appearance of a living- or dining-room

Plane straight one edge of four pieces of 1 by 3 in. S4S (surfaced four sides; that is, finished all over) stock of the wood chosen for the cornice and, of course, corresponding with the rest of the trim of the room. On the face side gage a line 1 in. from the jointed edges. Miter these pieces around the ceiling, keeping the straight edges on the chalk lines. Use eightpenny finishing nails, and keep as many as possible behind the gaged mark, where the overlapping cove will cover. Scrape out any hammer marks that appear outside of the line.

By means of two sticks measure the length of the room 6 in. below the ceiling and cut pieces of cove molding ⅛ in. shorter than the exact measurement. The upper edges may be cut back still farther to prevent them binding against the adjacent walls. Nail up the cove, tacking the upper edge to the 1 by 3 in. members on the ceiling and the lower edges to the studding. This allows of pulling the nails for readjustment before the cove is nailed up solidly afterward. To find the studs, tap the walls lightly and locate one stud positively by driving nails through the plaster, where they will hide behind the cornice. Then measure points 16 in. apart.

Next build a miter box about 8 in. wide and 8 in. deep, by nailing sides of 1-in. stock on a bottom of 2-in. material,

(Continued on page 107)



How the cornice is applied; a cross section, showing the backing joist, the ceiling strip, the cove molding, and the picture molding; and details of a coped corner joint and a central splice

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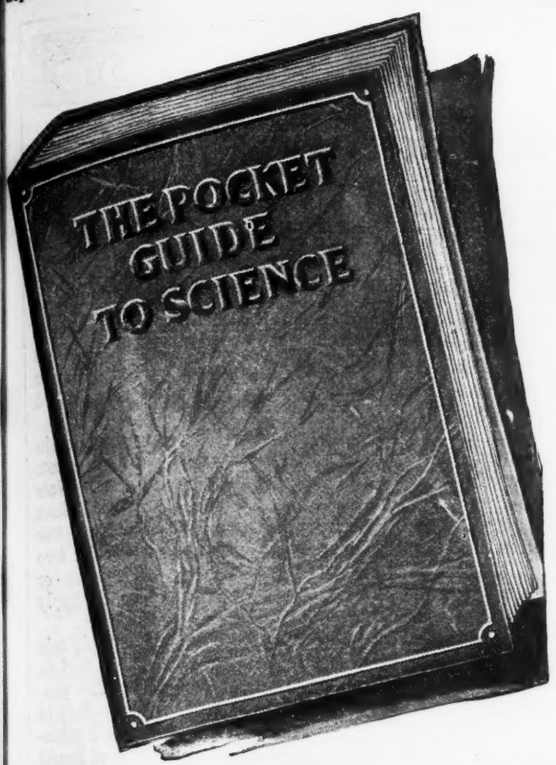

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Why does static interfere with radio messages?
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Why do we grow old?
What is the safest stimulant?
What is the function of the liver?
Why are tears salt?
Can energy be destroyed?
Why can't you skate on glass if it is smoother than ice?
How do self-winding clocks work?
Why does an iron ship float?
Can we see atoms with a microscope?
What are electrons?
Is electricity a form of matter?
What is a crystal?
How large is the universe?
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We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE TO SCIENCE *at no extra cost to you* if you use the coupon below immediately.

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SEND NO MONEY

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular you may return them and your entire payment will be refunded promptly and without question. Could any offer be fairer?

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I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman $2.95, plus the few cents' postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold.

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P. S. 9-25

Drives Machines Out of the Rut

THE common run of machines make commonplace *records*. But see those records on Veeder Counters, and you see the place for improvement!

You promptly see the improvement *register*, by closer watch of the running.

You get new "leads" to improved design, from the indications of *production-gains* on

Veeder COUNTERS

This small Rotary Rachet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further more the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines where a *reciprocating* movement indicates an operation.

Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50 subject to discount. (*Cut less than ½ size.*) Set-back *Revolution* Counter of similar model, $10.00 (*list*).

Write us about that counting problem of yours—or see how it's solved in the 80-page Veeder booklet; copy free.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

The Home Workshop

New Polychrome Finishes

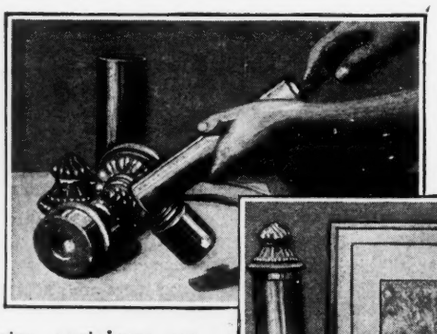
How to Decorate with Colored Bronze Powders Applied by Means of a Cheap Garden Spray

By William T. Weld

BY THE application of polychrome finishes that require perhaps less skill than any other method of finishing, you can beautify and rejuvenate many small pieces of furniture, picture frames, metal objects, lighting fixtures and other articles. Such a finish will cover up cracks, chipped or tarnished surfaces, and all sorts of blemishes.

The lower of the two accompanying illustrations shows a picture frame, two small electric lamps, a clock, a call bell, a piece from a dresser set, a tray and a vase that have been refinished in polychrome and are now quite attractive.

Polychrome means tinted with many colors; it is the finish now given to numerous floor and bridge lamps, mirror frames and novelties. The finish can be sprayed on with a garden or plant spray of the type having a glass container, usually to be purchased at seed stores for about 30 cents each. Several sprays make for a little faster work, but only one need be bought providing that several extra containers are obtained. These cost about 10 cents each.



The bronze powders may be had in a large number of different colors, but gold, silver, blue, green, red, and statuary bronze will be found to produce about all the variety necessary. These powders are put up in 1-oz. packages and cost about 25 cents an ounce. Most paint shops carry them in stock.

Several small brushes will be needed. The bronzing liquid (of the varnish, not "banana oil" type) costs about 50 cents for half a pint. A complete outfit should cost no more than a couple of dollars and with it you can do considerable work.

Perhaps there is a picture you wished to frame, but have not done so because of the cost. Almost every home has old framed pictures stored away in the attic or basement. These are often in pretty good shape and need only a little repair work to make them quite presentable.

First remove the old picture and the glass from the frame and wash the frame thoroughly with strong soap and water. Use an old toothbrush to clean around the corners and the raised places, if there are any. Buy 10 cents' worth of dental plaster of Paris at any drug-store. Mix about a teaspoonful with a little water until a stiff paste is formed. After wetting the surface upon which this is to be applied, take a small knife and build up each chipped place until it matches the rest of the surface. If the plaster becomes hard or sets before you have finished, you may cut or scrape it until the desired shape is obtained.

After all defects have been remedied in this manner, go over the patched places with steel wool or fine sandpaper. Now dust off the entire surface and wipe clean with a cloth moistened with turpentine or benzine. Give each patch a coat or two of the bronzing liquid or shellac or varnish. You now are ready to apply the colored bronzes.

If you want only one color, simply mix enough of the powder with the liquid to make it about like thin paint. The proportion of $^1/_3$ oz. (a level teaspoonful) of powder to 3 tablespoonfuls of liquid will be found quite satisfactory. After stirring this thoroughly it may be brushed on the frame.

Spraying the base of an electric lamp and a group of objects finished in polychrome

To produce the mottled polychrome effect, however, the spray should be used. Mix your color in the same proportions and place the frame on an old paper or stand it on edge and hang a paper behind it.

Your own taste will have to guide you in planning your color scheme. If you wish certain raised portions to be of one color and the sunken portions of another, simply spray the entire surface with the color you desire the raised portion to be. Let this dry for about 30 minutes and then apply the second color. While this is still wet, take a pad made from several layers of cheesecloth and wipe off the entire surface. This will remove the fresh color from the raised surface and at the same time expose your first color.

For a mottled effect spray on one color

(*Continued on page 106*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

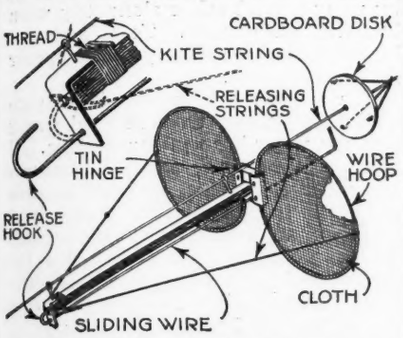
The Home Workshop

Unique "Butterfly" Travels up and down Kite String

KITE-FLIERS will find amusement in constructing this novel "butterfly." It is carried up a kite string by the wind to a point near the kite where a cardboard disk is located. Upon striking the disk the wings of the butterfly collapse and it slides to the ground.

The body, of light wood about ¼ in. square and 14 in. long, is mortised to a block ¼ in. thick and 1 in. square. The wire frame for each wing, which is about 9 in. in diameter, is fastened to the block by means of a piece of light tin secured by cigar-box nails, so that it will fold back easily. The wings are covered with cloth and painted with thick starch.

At the end of the body a bent piece of tin with two holes in it is fastened by wrapping



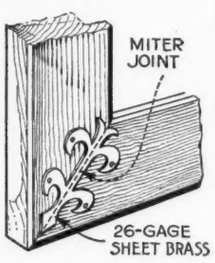
When the butterfly strikes the cardboard disk, the wings collapse and it slides back to earth

with thread and smearing with glue. A hole is drilled in the wooden wing block to correspond to the lower hole in this tin clip. A piece of stiff wire runs through these holes, one end terminating in a hook as shown. The other end projects about 10 in. beyond the block and ends in a right-angle bend. This is the end that goes toward the kite.

The kite string passes through a small screweye fastened at each end of the body. A string tied to the outside of each wing ends in a loop. When the butterfly is set for a flight upward, this loop is caught by the hook on the straight wire. The upward flight of the butterfly is stopped by a heavy cardboard disk, 3 in. in diameter, which is fastened on the kite string near the kite and braced with stiff wires.—EDWIN G. GETTINS.

Metal Corner Pieces Conceal Cracks in Picture Frames

LARGE picture frames often become unsightly because the mitered joints crack open. If the frame is not molded too elaborately, the joints can be concealed with ornamental corner pieces cut from No. 26 gage sheet brass or copper. These are fastened in place by means of small escutcheon pins. The metal may be colored or left bright, as desired.—W. J. E.



Here's an Ad

that wins men by its fairness

Don't buy yet—wait till the 10-day tube we send you proves its case

GENTLEMEN:

Palmolive Shaving Cream is today the leader in its field.
Yet we urge men not to buy it before they try it.
Our whole case rests on a 10-day tube that we send, free, for a test.
On that basis we have won the world to this new creation.
Men by the millions are flocking to it. Its success is a business sensation.

Give us ONE chance

We realize you are probably wedded to another shaving cream.

But, as expert soap-makers (we make Palmolive Soap, you know, the world's leading toilet soap), we know a fair comparison 80 times in 100 will win you.

Palmolive Shaving Cream is a unique creation. There is no other like it.

It embodies the four great essentials 1000 men expressed as their supreme desires in a shaving cream—plus a fifth, strong bubbles, the most important of all.

60 years of soap and skin study stand behind it.
130 formulas were tested and discarded before the right one came.
10 days of its delights, we believe, will win you to our side.
Now as a courtesy to us, will you mail the coupon and accept those 10 shaves free?

5 New Joys

These you'll find—these new shaving joys, these comforts unknown before:

1 Multiplies itself in lather 250 times.
2 Softens the beard in one minute.
3 Maintains its creamy fullness for 10 minutes on the face.
4 Strong bubbles hold the hairs erect for cutting.
5 Palm and olive oils bring one fine after-effects.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream.

PALMOLIVE SHAVING CREAM

2953

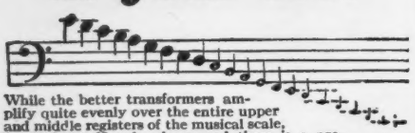
10 SHAVES FREE and a can of Palmolive After Shaving Talc

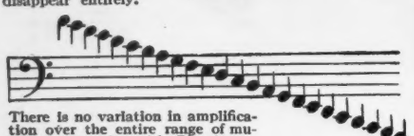
Simply insert your name and address and mail to Dept. B-1058, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill.

Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

.....

What becomes of the *bass* notes in your set?



While the better transformers amplify quite evenly over the entire upper and middle registers of the musical scale, from about 60 cyles downward there is a pronounced loss of amplification, as indicated above. Poorer transformers begin to drop off in amplification even higher on the scale with the result that lowest notes disappear entirely.

There is no variation in amplification over the entire range of musical frequencies with Thordarson **Autoformers.** No note is too low—no note is too high to be lost by the Autoformer. In addition there are three other advantages.

Four Great Improvements

Full amplification of those *bass* notes hitherto largely "lost"! Greater clarity on *all* signals! Improved reception of *distant* programs! Better volume *control!*

These are the four advantages achieved by this latest Thordarson development — the Autoformer. Thordarson has succeeded in utilizing, for the benefit of your radio set, the same principle used in the line amplifiers adopted by the more recent high-powered broadcasting stations. The excellent quality of these stations (due to perfect amplification) offers conclusive proof of Autoformer effectiveness.

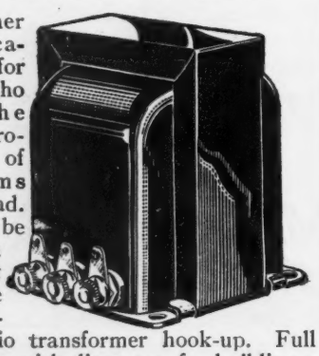
Unconditionally Guaranteed

THORDARSON

Autoformer

Trade-Mark Registered

All Frequency Amplifier



Autoformer amplification is for those who seek the finest reproduction of programs to be had. It may be used with any set in place of the regular audio transformer hook-up. Full directions, with diagrams, for building a Thordarson Autoformer Amplifier are supplied with each instrument. Or

Write for the Autoformer Hook-up Bulletin—Just Out!

THORDARSON ELECTRIC MANUFACTURING CO

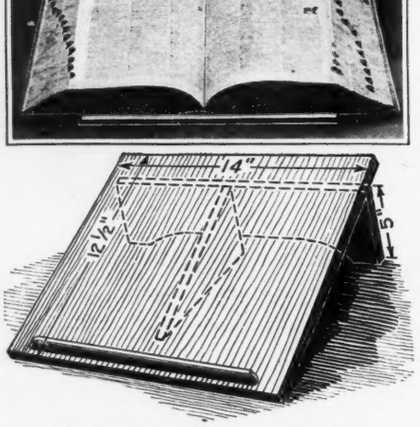
Transformer Specialists Since 1891

WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS

Chicago, U.S.A.

The Home Workshop

Neat Desk or Table Stand for Large Dictionary



CROSS-WORD puzzles caused the unabridged dictionary to become better appreciated as a reference book for home use. Its main drawback is its cumbersome size, but that can be minimized by constructing the table stand illustrated. The dictionary then may be consulted without leaving the desk or table.—J. P

New Polychrome Finishes

(Continued from page 104)

and then another until the desired result is obtained. Gold or silver first, then blue, green, and red is a good order.

In using the sprays and bronzing liquid in this manner you do not need to wait until each separate color is dry. The only precaution to take is to avoid too much liquid at one time, otherwise the surface will become streaked.

You will be delighted with the way the spray of one color blends with another. The best part of applying this kind of finish is that you can't spoil it. Should you get on too much of any one color, simply tone it down by spraying on a little gold or silver.

If you have several small articles of one kind to finish, place them close together while spraying.

If you plan to do considerable work, it will be found economical to buy some shellac or ordinary varnish in place of the bronzing liquid. The varnish should be thinned with turpentine and the shellac, if necessary, with alcohol.

If you desire a rough surface similar to that on much of the commercial polychrome work, a very simple method is as follows: With a brush apply a very heavy coat of what is known as paste wood filler. Do this to the surfaces you want left rough and let it dry for about 30 minutes. Tap this lightly with a stiff brush until it is quite rough. Let it dry for several days, then sandpaper it very lightly to remove the sharp tips. Let this harden for a week, apply a coat of shellac or varnish, then spray as desired.

Household articles on which this colored bronze finish is appropriate are electric fixtures, gas fixtures, shelf brackets, wall registers, door-bells, open plumbing, radiators, spice cans, bread and cake boxes, candle-sticks, mirror frames, metal waste baskets, and book racks.

Mats of Corn Husks

(Continued from page 94)

braids back and forth instead of around. Be sure all the husk ends are on the same side, which is to be the top. They should not be cut off except sufficiently to reduce them all to the same length. The resulting mat will last almost a lifetime, if dried out whenever it gets wet.

While these look well in their natural color, they are more attractive if colored. This can be done either before or after making. Pretty effects may be obtained by using several colors alternately when braiding the strands. To color husks, let them stand in ordinary clothes dye for six hours or more.

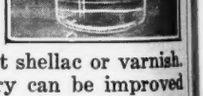
The husks can be made almost pure white by washing them in good strong soap and water in a washing machine. If this is done before dyeing, the colors will be brighter. Be sure, however, to wash out all the soap, if you intend using dyes.

Rugs, mats, and table mats can be made by the same method, except that the husks should be used singly or split into small shreds. All the ends in this case should be cut off when dry.

A sewing basket may be made by winding tightly made braids, with all the ends cut off, around a form of round or square sticks. Sew the braid together as the work progresses. The turns go alternately inside and outside the sticks, as shown. The lid is stiffened with heavy wire reinforcement and has a tassel or ring in the center to serve as a handle. These baskets look best if varnished. —RALPH ALLWINE, Shelby, Ohio.

Improving Cheap Jewelry

ALTHOUGH heavily gold- or silver-plated in front, some grades of jewelry soon wear down to the brass base on the back. Wrist watches, rings, and other pieces of this kind are apt to leave a black deposit on the skin. The tarnish may be prevented, however, by coating the



Coating back of wrist watch and "silvering" a ring in old "hypo"

back with transparent shellac or varnish.

Cheap brass jewelry can be improved in appearance and wearing qualities by suspending it overnight in old, much used "hypo" solution, obtained from your local photographer. The jewelry becomes coated with the silver dissolved in the hypo from photo films and papers.—K. B. M.

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The Home Workshop

Easy Way to Build a Cornice

(*Continued from page 102*)

and sawing through both sides at angles of 45 degrees. Cut four pieces of cove molding 6 in. longer than half the remaining sides of the room, and miter back one end of each to get the profile of the curve as a guide for cutting.

Cut the curve with a coping-saw held in a plane parallel with the top of the molding; or a narrow, fine-toothed cross-cut saw may be used. With a sharp chisel trim the cut toward the back to make certain that only the surface edges will bear against the mating mold that already is up.

HOLD one piece in position against the ceiling, tacking if necessary to remove kinks, to test the fit with the other cove. If the joint is poor, scribe with a pair of dividers and cut again, or trim the high points with a block plane. When a first-class fit is attained, tack in position and mark the other end at the center of the wall.

Fit a length to the opposite molding in the same way and nail up solidly. Finish the remaining wall in the same way.

Cut two blocks of 2 by 6 in. stock 8 in. long. Taper these from a width of 5 in. on one end to 3½ in. on the other, curving the edge inward for the sake of neatness. Cut a cardboard pattern to fit the curve of the cove, and use it to lay off the edges by which the back of the block may be chiseled. After careful fitting, curve the front face or, if desired, carve a leaf on each for further ornamentation, and nail up with sixpenny finishing nails. Fit similar blocks in the centers of the side coves.

Put up the picture molding in four pieces, since the joints are easier made and the lengths may be sprung into place, exerting great pressure at the joints, sufficient to close them in spite of small irregularities. As a gage, hold a ⅜-in.-thick strip of wood between the top of the mold and the bottom of the cove, so that space will be provided for picture hooks.

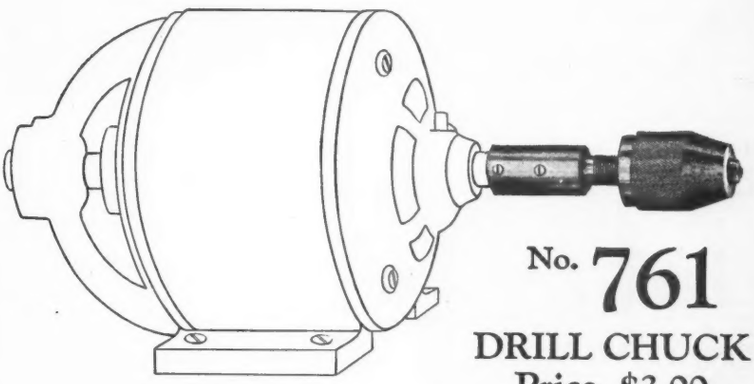
IF THE builder feels disposed to put up full-length coves, he should leave the ends of the first pieces a trifle loose, so that pressure from the next piece will spring it to shape against its joint curve. It is also well with such large moldings to put up each piece in succession, so that only one joint is cut on the end of all but the last piece, allowing of a little "give and take" for fitting. Or, the pieces may be put up full length without special care being taken with the corner joints, these being covered with ornamental blocks.

If lead wires in loom are tapped from the electric wires and run behind the cove, suitable light fixtures can be put in the corners, hiding the joints and aiding the illumination of the room. In the latter case, however, city ordinances probably will require official inspection.—E. M. L.

"HOW to Cover Cracked Plaster with Wallboard," by Edwin M. Love, is one of many helpful articles for home owners scheduled for the October Home Workshop.

Attachments that give your motor more uses

WHY not equip your motor for drilling, grinding, polishing, and buffing? The Goodell-Pratt small motor attachments make it easy. Just fit any of them on the shaft and the motor is ready to go to work.



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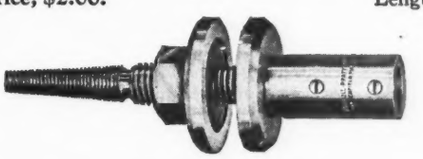
DRILL CHUCK
Price, $3.00

No. 757 Drill Chuck: Fits motors with ⅜-inch shaft. Similar to No. 761, but smaller. Holds round shank drills from 0 to 5/32 inch Length 3⅛ inches. **Price, $2.00.**

Fits motors with ½-inch shaft. Enables you to drill in iron or steel. Three hardened steel jaws hold round shank drills from 0 to ⅜ inch in diameter. Length over all, 4¼ inches.



No. 762

Saw Arbor and Buffing Spindle: Has a shank that can be fitted on a ½-inch shaft. Arbor takes grinding, polishing, and buffing wheels, wire brushes, etc., with ½-inch hole. Flanges open ¾ inch. The tapered spindle on the end of the arbor has a deep, clean thread for handling the great variety of wood-centered wheels. Length, 5¼ inches. **Price, $3.00.**

Saw Arbor No. 758: Similar to No. 762 above, but smaller and without the tapered spindle. The shank fits a ⅜-inch shaft and the arbor will take saws or wheels with a ⅜-inch hole. Opening between flanges, ½ inch. Length over all, 3¼ inches. **Price, $1.50.**

No. 759

Buffing Spindles: Have a clean, deep, tapered thread for holding wood-centered wheels. They are made with both right and left hand threads. The shank is made to fit a ⅜-inch shaft. Length, 3⅛ inches.

No. 759. Spindle with R. H. threads, **Price, $1.00.**

No. 760. Spindle with L. H. threads, **Price, $1.00.**

Write for Catalog No. 15

See all the other of the famous 1500 Good Tools that Goodell-Pratt make. All are shown in the big general catalog. Write for a copy. It's free.

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Makers of Mr. Punch

GOODELL-PRATT
1500 GOOD TOOLS

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Can one tobacco satisfy a man with 45 pipes?

You might imagine that the law of averages would require a man with 45 pipes to smoke a variety of tobaccos.

Evidently, it doesn't work that way, for here is a pipe connoisseur who after vainly trying every tobacco his tobacconist could mention, finally got around to Edgeworth. The result is, his humidor is now "Edgeworthized."

Mr. Sonnenblick makes application for a life membership in the Edgeworth Club. All in favor say "Aye."

But first read his letter:

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

When a man has 45 pipes he certainly is up against it for an all-round tobacco. But first, about my pipes. There are 2 Dunhills, 6 Comoys, 4 BBB's, 4 Kaywoodies, 2 Petersons, 2 GBD's and the usual meerschaum, calabash, corncob, etc. Some were sweet from the start, others remained obdurate and bitter despite the fact that I used every American brand and every English brand I could get or my tobacconist could mention.

Fancy prices! Hang the price. I wanted pipe satisfaction. The brands I tried failed; the mixtures I made failed because the tobacco varied.

I saw the ads written by Edgeworth smokers, but they sounded too good to be true. I didn't try Edgeworth in despair, but just to see how less bad it might be. Well, it's praise enough when you know that my office humidor has been Edgeworthized. Now my good pipes taste better and my bad pipes taste good.

If you've got a life membership open put me down. It's the King Bee of tobaccos and I think I'm a qualified judge.

Respectfully yours,
Ira J. Sonnenblick.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10-I South 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

The Home Workshop

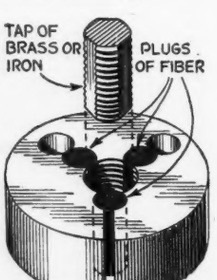
Canvas Strip Used as Campers' Shoot-the-Chute

THIS is perhaps the cheapest, lightest, and most easily transported shoot-the-chute that the camper can make—simply a length of heavy canvas about 2 ft. wide provided with a grommet in each corner. One end is attached to a tree limb and the other end to two posts, or anchored to the bottom by means of heavy rocks.

Adapting a Die to Thread Hard Rubber and Fiber

IN RADIO and other work it is difficult to cut clean threads with an ordinary die on rods of hard rubber, fiber, and similar materials. The crumbling of the threads can be overcome by modifying the die as shown in the illustration.

First run a thread on a rod of brass or soft iron and then file three flats on it to make it nearly triangular in cross section. This is to serve temporarily as a tap.



Die fitted with plugs

Plug the clearance holes in the die with the same material that is to be threaded and use the improvised tap to clear out the die. This gives the die the appearance of a plain threaded hole, except for the difference in color between the filling material and the steel. The clearance-hole plugs serve to support the threads as they are cut.—W. J. E.

Drill Press Cheaply Built

(Continued from page 82)

should be machined down to fit into the ball bearing selected for this point. In order to machine this gear, it must be annealed. This may be done by heating to a cherry red and holding it at that temperature for a time, after which it is allowed to cool very slowly. It is likely that the gear will need to be bushed and a new key provided.

The gear *W* carries a fixed key that allows the keyway in *A* to slide freely over it. The ball bearing that carries *W* is larger than the others and requires a larger piece of tubing to mount it. G^2 is the same diameter as G^1. It has feet welded to it to support it on *D*. The shaft *A* is made from a propeller shaft and the shaft *B* from an axle shaft.

The ball bearings that support the shaft *B* are mounted in steel blocks *QQ*. These are turned in the lathe to fit into the pipes *FF*, which are split and provided with bolts for clamping.

The author purposely has refrained from going into minute detail with reference to part sizes. A great deal of satisfaction comes to the builder of a piece of equipment of this nature in knowing that he has incorporated some of his own ideas. It is a good plan to gather together every possible part that might work into a projected machine and see how they will lend themselves to the plan. The most intricate parts should receive first consideration. Each part used will be found to have a definite influence on other parts and on the design of the entire machine.

The chuck provided for this machine is of the conventional design. It is driven by a ½-horsepower motor having a speed of 1800 revolutions a minute and carrying a 3-in. pulley. This gives a serviceable range of speeds.

How to Repair a Clutch

(Continued from page 98)

garage or arbor press is the usual method, but the ingenious owner-driver can improvise a jack, vise, or pry arrangement that will do the work.

Where equipment is limited for handling this particular job, some mechanics use a couple of long studs threaded to fit the flywheel rim and thus by assembling the clutch in the flywheel they are able to draw the cover plate down and at the same time compress the spring.—R.F.K.

Light Wire Holder Clamps Ink Bottle on Drafting Table

ALTHOUGH various ink-bottle holders are at the disposal of a draftsman, I have found the device illustrated to be especially satisfactory. It is made of a single piece of spring brass wire bent as shown. The loop passes over the neck of the bottle and rests snugly against the shoulder.—A. C. SELETSKY.

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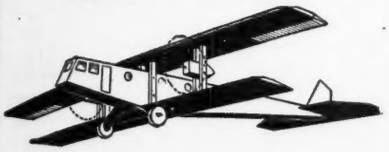
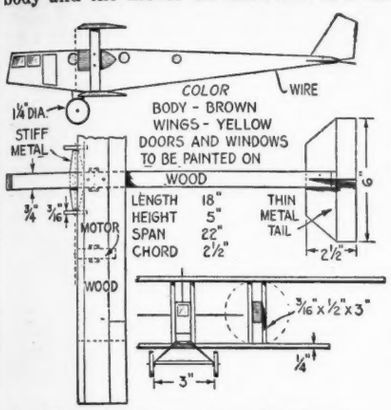
The Home Workshop

Toy Aerial Express Cruiser Made with a Pocket-Knife



BUILT for carrying many passengers, an aerial express cruiser is a giant airplane. This toy model of one is, therefore, larger than the three airplane models previously described in this series, but it is on the same scale and in correct proportion to them.

The body is whittled from a piece of clear white pine or other soft wood ¾ by 2 by 17 in. The upper wing is ¼ by 2½ by 22 in.; the lower, ¼ by 2½ by 16 in. Each of the two motors is whittled from a wooden block ½ by 1 by 2 in. and is supported by two strips 3/16 by ½ by 3 in. as shown. The distance between the body and the motor on each side is 3 in.



Side, top, and front views of the fourth in a series of realistic toy airplanes

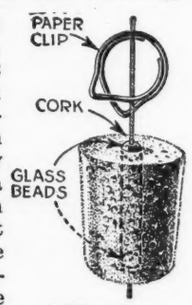
It will be noted that the two small strips that support each motor also brace the upper wing, and two similar strips are used to attach the center of the upper wing to the body.

The landing-gear, tail members, and propeller, as in preceding models, are made of thin sheet metal. The wheels are 3/16 by 1¼ in. wooden disks.

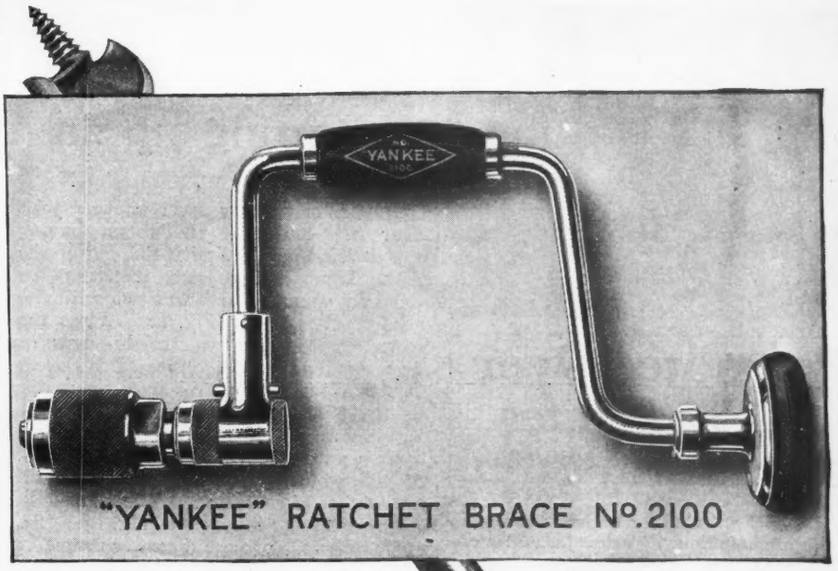
The next toy in this series will be a transatlantic air-liner.—D. W. C.

Adjustable Float for Fishing

BY BEING free to slide on the line, this adjustable float allows the fisherman to reel in his line completely when through fishing. It is merely a large cork with a ¼-in. hole through the center, bushed at each end with a large glass bead. The fish-line runs through the beads. When you are ready to cast, simply push a small wire paper clip over the line at about the point at which you wish the float to remain.—L. B. R.



Sliding float



Any bit stays tight in this chuck

Here, at last, is an efficient bit-brace chuck.

Slip into it any shape bit (round, square, any taper), and the bit is held in a vise-like grip.

Saves time by centering bits accurately, and locking and releasing them instantly. Ball-bearings give chuck the easy action in your hand.

With it you can do every kind of boring job within the scope of a bit-brace.

"YANKEE" Ratchet Bit-Brace No. 2100

A touch on the *easy-acting* Ratchet Shifter gives you a powerful ratchet that works without needing a hand to prevent chuck from turning back. Ratchet is bronze-encased against dust and moisture.

"Yankee" introduces for the first time hard rubber Brace handles. Won't warp, shrink, bind or crack. A patented method prevents excessive play in sweep handle.

Finished beautifully in keeping with its perfect mechanism. See it today in the "Yankee" Counter Demonstrator, at your dealer's.

Made in four sizes—8-, 10-, 12-, and 14-inch. Chuck holds rounds up to ½-inch; 14-inch Brace holds up to 5/8-inch square.

Try This Test

Put Auger Bit into chuck of "Yankee" Brace. Bore deep into tough wood. Then pull upward with all your strength. Bit will not come out of chuck.

Dealers everywhere sell "Yankee" Tools

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability

Write for FREE "Yankee" Tool Book

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"YANKEE" TOOLS

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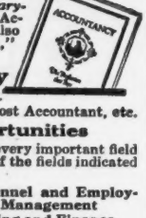

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The Home Workshop

Fitting up an Unfinished Attic

(*Continued from page 79*)

In the same way level another joist near the center of the room, having first leveled one end with the end of the first. Intermediate joists then may be lined by spanning the first two with the straight-edge, as in Fig. 2. Unless the joists all are planed to straight-edges, or have equal amounts of crown, it is useless to attempt to obtain levels from the center of any joist. It is extremely important to bring all joist ends into the same plane.

To prevent canting of the floor joists, fit pieces of 2 by 10 in. stock between all bearing ends. They may be placed in a direct line or staggered (Fig. 2). If a span is 8 ft. or more, a center course of herring-bone bridging is required. The length of each piece from the obtuse angle, or "short point" of one end to the acute angle or "long point" of the other is the hypotenuse of a right triangle with a base equal to the distance between the joists and the side 7¼ in., while the angle cut is, of course, an acute angle of that triangle. If the joists are spaced evenly, one piece should be a pattern for all.

Strike a chalk line to guide by, and nail the bottom ends of the pieces as illustrated at the bottom of Fig. 2. Do not nail the upper ends at this stage.

Nothing but vertically grained flooring should be used, and preferably the lengths should reach across all joists, eliminating

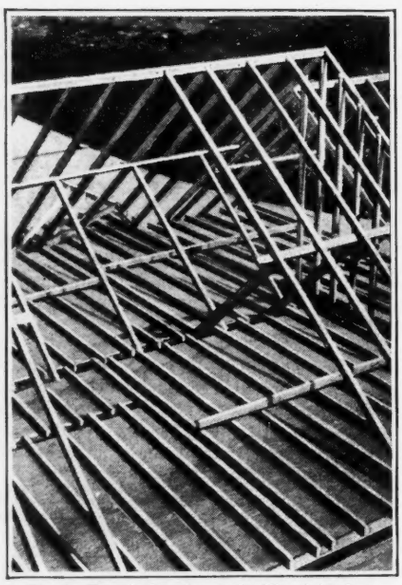

Fig. 4. Rough framing and ceiling joist layout showing the roof braces to be removed

joints. If joints are necessary, make them on the joists, cutting with a fine-toothed saw and beveling under slightly to insure a tight fit on top. Take care, if the flooring is surfaced on the under side, not to nail a board upside down. The right side, as shown in Fig. 2, is farther from the tongue and groove than is the wrong side. Also, the upper lips are longer than the lower, that the joints between boards may come tight on top. A board upside down is evidenced by the surface being lower than its mates, and its stubborn refusal to nail up closely to the first board.

Lay the first board to a straight line, nailing through from the face, as the partition plate covers it. Blind nail the following boards, using eightpenny wire box nails, and working from one end to the other. If firm tapping with the side of the hammer and subsequent nailing do

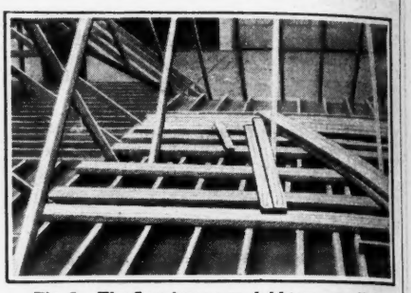

Fig. 5. The floor beams are laid temporarily across the ceiling joists to form a platform

not force a board into place, use a scrap of flooring as a buffer, striking heavy blows with the hammer or a hand ax. All splinters on the tongue should be removed carefully. To avoid loose and creaking boards, drive the nails firmly home, and if this cannot be done without hammer marking, use a nail set for the last blow or two. Sometimes a hammer dent can be taken out by moistening the bruised spot, thus swelling the crushed fibers. The outer ends of the flooring need not be smoothly cut.

When the center of the room is reached, the joists then being brought into alinement, nail the upper ends of the bridging. The flooring then may be completed.

If it is desired to surface the floor, it may be scraped smooth at this time provided it is covered immediately to prevent marring during later construction. The advantage in scraping it at this stage is the absence of walls, which makes it easier to smooth the extreme margins.

How to continue from this point will be told in the second article of the series in next month's POPULAR SCIENCE MONTHLY.

Novel Violin Bridge

SINCE adding a weight such as a mute to the bridge of a violin softens or deadens the tone, it occurred to me that removing weight would have the opposite effect. A violin bridge, therefore, was cut out as shown, leaving it strong enough to support the strings, but with no superfluous wood. All the edges were rounded to give it a neater appearance and also to lessen the weight. One-third the original bridge was removed. The result was a noticeable increase and improvement in the tone.—J. H. DOWNIE.

Violin bridge

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

HOW often have you wished for a water-resisting cement that would join glass, metal, and wood, or a combination of these substances, tightly and firmly and would not give way under hard usage? Such a cement is described below.

When fastened together by it, articles can be placed in water for months without any injurious effects. Aquariums can be cemented with it, and the glass sides will not require any outside support. It will hold glass by the edges alone and at the same time resist the action of the water. Broken glass or porcelain can be mended with it, metals can be joined together, and metal can be attached to wood. This is of special value in resetting tool handles.

The cement must be prepared in either a porcelain dish or in a beaker that can be heated. Make only a small quantity at one time, for very little is required to do considerable work.

Pouring creosote into beaker (below) and adding shellac to hot creosote while stirring (at right)

Creosote and dry flake shellac are required. Just pour enough creosote into the beaker to cover the bottom of the dish. Heat over a small flame such as an alcohol lamp and add the shellac gradually while stirring the mixture. Add enough shellac to the hot creosote to make a very thick, syrupy solution. Allow this to cool, when it should be so hard that it is difficult to make a deep impression in it with a fingernail. The adhesive power will be slightly greater by having the mixture still thicker and harder, but then it is slightly more difficult to work with.

In order to use this cement the parts to be joined must be heated to a temperature sufficient to melt the mixture. The cement is applied hot by means of the stirring rod used in mixing the chemicals.

The hot cement can be applied to the parts to be mended, even if they are only slightly warm, but then the joints must be heated over an alcohol flame so that the cement runs freely and enters and spreads uniformly. The parts to be mended will not be tight unless the joints are heated sufficiently to melt the mixture. The thinnest film, if properly applied, will hold as well or better than a thick blob of the cement that will not adhere to the mended parts.

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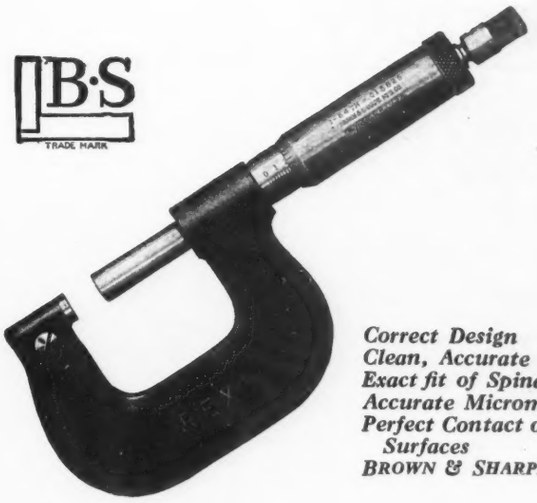

Correct Design
Clean, Accurate Graduations
Exact fit of Spindle in Frame
Accurate Micrometer Screw
Perfect Contact of Measuring Surfaces
BROWN & SHARPE Quality

The "Rex" gives you all these things

In examining the "Rex," you will first be impressed with the careful workmanship, the clean cut graduations, the polished thimble and barrel, the smooth, enameled frame. The "Rex" is a High Quality Micrometer—only the price has been left moderate. Hold the "Rex" up to a strong light and turn its spindle down against the anvil. You will notice how accurately the measuring surfaces come together. Then there's the micrometer screw—the heart of the micrometer—cut to a standard.

—Remember, the "Rex" is a Brown & Sharpe Micrometer of the Brown & Sharpe Standard of Accuracy.

"Rex" Micrometers which measure up to 24", and over 2000 other tools are listed in the Brown & Sharpe Small Tool Catalog No. 29. Copy gladly sent to you upon request. You'll notice a real superiority in all Brown & Sharpe Tools when you look them over.

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POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Better Shop Methods

(*Continued from page 84*)

Kinks that Make My Work Easier

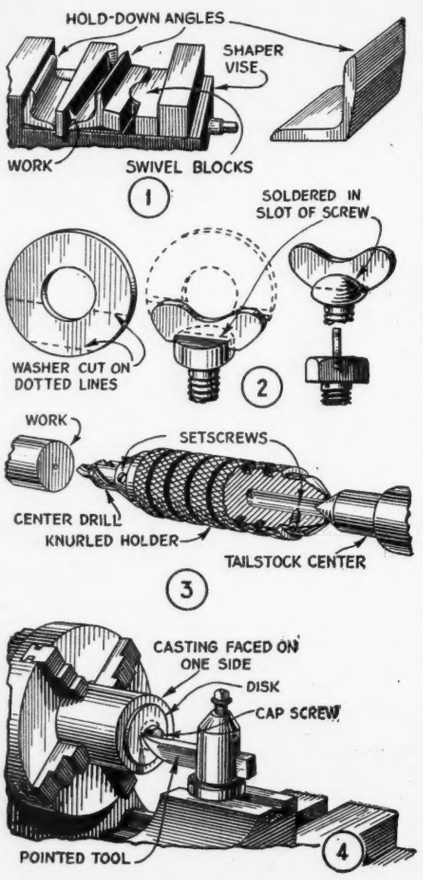
By E. C. Fellows

MY SHOP work is made easier by a few inexpensive machine accessories and tools and some simple shortcuts. Four examples are given below, not so much because they are out of the ordinary as because they will suggest similar and perhaps better expedients.

Time is saved on shaper work by using a set of hold-downs made as shown in Fig. 1. On one side of a piece of angle iron, just double the length of the vise jaws, I planed an angle of about 1½ deg. as indicated. The angle iron then was cut in half to make a pair of hold-downs. It is better to have the side next the vise jaws shorter than the other side.

To aid in clamping tapered work in the shaper vise, I prepared a swivel block to use on one side of the taper, using it in connection with the hold-downs. The swivel blocks are made of cold rolled or machinery steel. One block has a circular projection that fits into a corresponding seat in the opposing block. The blocks have a ¾- or 1-in. space between their inner parallel faces. The dimensions of the blocks and the hold-downs may be varied.

One day I needed a few thumb-screws in a hurry and, as there was none in stock of the right size, decided to make them. The method I followed was not only quick and cheap, but saved the time that the work would have been delayed while awaiting the arrival of purchased screws of the correct size. An ordinary washer and a fillister-head machine screw were used as shown in Fig. 2 to make each thumb-screw. The washer was cut in half and soldered into the slot; the projecting ears then were filed round. This made a thumb-screw of good appearance that served the purpose quite as well as a commercial thumb-screw. In the figure are shown variations of this idea to suit different styles of machine screws and bolts.



Hold-downs and a center drill holder; methods of making thumb-screws and thin washers

Figure 3 illustrates a tool that saves much time in centering work in a lathe. It is a holder for a combination drill and countersink of the conventional kind. The holder is made from a piece of cold-rolled or machinery steel 1½ in. in diameter, with a hole drilled and reamed in both ends. The holes are made to accommodate two sizes of drills corresponding to the sizes in general use. A setscrew is used to lock the drill in place. In drilling the holes it is important that they should be in line with each other and true to size. The ends of the holes are chamfered slightly to fit the lathe center and the outside is knurled to provide a hand grip on the tool while it is in use.

Turning and finishing a thin disk or washer in a lathe is not always an easy task and some machinists make a poor job of it or spoil a few before they turn out a good one. When I have a job of this kind, I proceed as follows: If the disk is made of sheet steel or iron, which is the usual and by far the most economical way, I first face one side of it. Then I find a round casting of suitable diameter and chuck it in the lathe as seen in Fig. 4. Next, I face off one side and drill and tap a hole in the center for a bolt or capscrew. I then clamp the disk on the casting by means of a capscrew and a small washer. The two finished faces abut each other. By taking light cuts with a sharp pointed tool, I reduce the metal to the right thickness and then finish the outside diameter.

If the inside diameter is to be finished to a specified size, the disk can be held to the casting with three small screws on the outside. Remove the central screw after tightening up the outside screws and proceed to turn the inside diameter. Remove the sharp edges with a file, and the piece is finished.

By this method I have made washers 1/64 in. thick that were true and parallel in thickness.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

Better Shop Methods

Old Bill Says—

THE right man can make a good job out of any job.

Back gears should be used only when more power is required to pull a heavy cut, or when the speed must be reduced to cut exceptionally hard or tough materials.

Old Bill, machine-shop foreman

One way to avoid getting a square deal is by not giving a square deal yourself.

Before beginning to lay out a piece of work, it is necessary to have a definite idea of what the drawing means, a full knowledge of the operations through which the work must pass, and some idea of what is to be expected of the job when finished and returned to its shop.

Keep thinking about the next move you are to make; learn to think ahead.

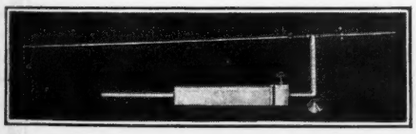
Use a handle on a file when filing in the lathe.

When melting babbitt, stir in some rosin or oil. This will purify and thin the metal, and all foreign matter will come to the top.

Initiative means doing the right thing at the right time without being told.

Any machinist can become a master of his craft by constant application and study. Magazines, books, night schools, and correspondence schools all help.

Universal Test Indicator



CERTAIN shortcomings of the ordinary test indicator are met by the one illustrated above. The rod running through the shank of the tool can be adjusted to suit the work at hand and locked in position by a knurled screw. This is vital on difficult work where the center-punch mark to be indicated is far back from the front of the work. Since the indicator rod must be 18 in. from the point in some kinds of my work, it can be seen that the standard indicator could not be used.

A detachable cone-shaped point is used to indicate a hole. It is attached to the rod with a screw. Collars, springs, and two ¼-in. balls keep the indicating rod tightly in place against the ball seat.—HUGO LJUNGQUIST, Philadelphia, Pa.

The telephone door

More people enter our homes and offices by telephone than in person. Through the telephone door, traveling by wire, comes a stream of people from the outside world on social and business missions. Important agreements or appointments are made, yet the callers remain but a few seconds or minutes and with a "good-bye" are gone. We go out through our telephone doors constantly to ask or give information, buy or sell things, make personal calls and on dozens of other errands.

None of the relations of life is more dependent upon co-operation and mutual consideration than these daily millions of telephone journeys. It is the telephone company's part to furnish the means of calling and to place courteous and intelligent employees at the service of the public. Good service is then assured when there is a full measure of co-operation between users.

Only by mutual care and consideration can everyone enjoy the full pleasures and benefits of calling. Telephone courtesy is for the good of all who use the telephone door.

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AND ASSOCIATED COMPANIES
BELL SYSTEM
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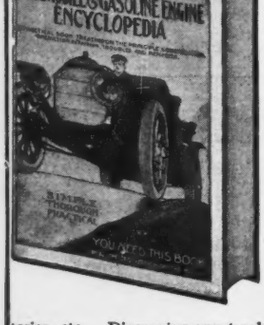

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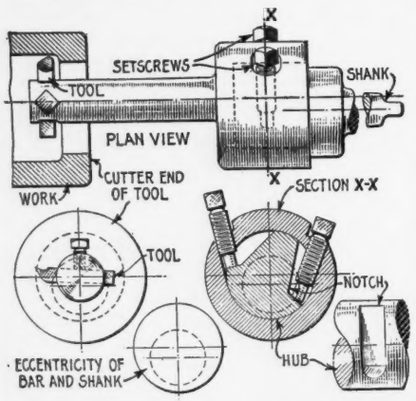
Better Shop Methods

Special Lathe Boring Tool Has Running Adjustment

EASE of adjustment is the special feature of the lathe boring tool illustrated. It is not necessary to stop the work to withdraw the boring head so as to set the tool out from the bar.

One end of the shank is tapered to fit the tailstock spindle. The other end is provided with a hub, which is about ¼ in. off center. It is fitted with a corresponding sleeve, which is a snug fit. The bar



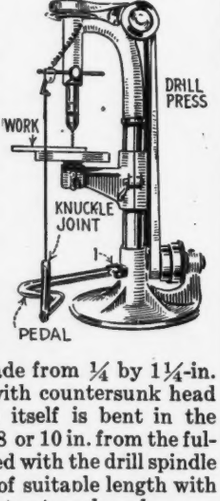
Without withdrawing this boring bar from the work, the tool may be set either in or out

extending from the sleeve is of the conventional type and has a cutting tool held with a setscrew.

Two setscrews pass through the sleeve and bear against inclined seats in the hub. With a socket wrench on each setscrew, it is possible to release one screw and tighten the other. This rotates the toolbar and, as the hub is eccentric, movement in one direction places the cutting edge farther out from the center within the ¼-in. limit.—G. A. L.

Foot Lever Feed for Rapid Work on Small Drill Press

MANUFACTURING work on high-speed drilling machines often can be handled more quickly if a foot-lever feed is attached to the spindle. The general arrangement of such a pedal is illustrated.



The pedal arm is attached to the base of the machine by means of the clevis marked 1, made from ¼ by 1¼-in. iron and fastened with countersunk head screws. The pedal itself is bent in the form of an S about 8 or 10 in. from the fulcrum. It is connected with the drill spindle by means of a rod of suitable length with ball or knuckle joints at each end.

The handle used for hand feeding should be set horizontally and fitted with a spring to raise it when pressure on the pedal is released.—F. J. WILHELM.

A new Parks! Cabinet Shop Special No. 7 $250

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Make a real shop in your basement!

This handy Parks woodworker is complete shop equipment in itself. With it you can do all sorts of cabinet work. Make toys, furniture, radio cabinets—anything. Built for close, accurate work, yet small enough to fit in a corner of your basement. Operates from light socket. Has motor, rip and cut-off circular saw, jointer and bandsaw. Add lathe and shaper at slight extra cost. A real machine ideal for home use. Send for circular.

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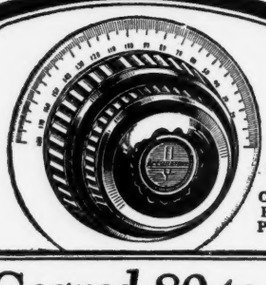
PARKS WOODWORKING MACHINES



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15 CAMPBELL STREET
NEWARK, N. J. Ⓢ

ACCURATUNE

Better Shop Methods

Chasing a Difficult Thread

(Continued from page 84)

in diameter that had come in to have some missing teeth replaced. He nodded approval when he saw 1-in. studs being screwed in with a 2-ft. pipe-wrench.

"I am glad to see that you are getting them in tight enough to stay," he said.

Laten, the machinist, kept on with his work. Old Bill wandered on. When he came back a few minutes later, the last stud had been screwed in and sawed off. The machinist had begun to chip them.

As Old Bill approached he was chalking the ends of the studs and, with dividers set from good teeth, spacing off the ends of the teeth, always spacing from a good tooth.

"That is the best way to make them accurate, Bob," Old Bill said. "Get a thin piece of sheet iron and make a template so that you can get the curves of the teeth about right. Hold the sheet on the side of some of the good teeth and scribe the outline so that you can cut it to the shape of the teeth. There is one other thing that you can do:

"Clean out several of the good teeth and cast a babbitt imprint of them that you can use to try on your studs to be sure there are no high spots to pound every time the wheel goes over. Clamp a board on each side of the teeth and fill up about three teeth with babbitt, and have a web to connect these teeth. Then you can use these babbitt teeth to 'spot in' the new teeth."

"I had been wondering how I was going to get them just right," Laten said.

"You will not be able to get them just right," Old Bill replied; "but you can get them pretty nearly so by using all three of these methods."

OLD BILL could tell by the group gathered about the big radial that the thread-cutting job was about to commence. He went over to watch the proceedings.

"I thought I would bore the hole round with a flat tool before cutting the thread," the machinist explained.

"That is a good idea; it will give you a better chance to set your threading tool."

The drill had a tapping attachment, so the cutting of the thread was not so hard as it might seem. The thread tool was set for a light cut. It was run down slowly the first time. Old Bill held out a hand.

"Now, in bringing it up again, be careful that you do not spoil the thread you have started," he said. "Do not let the screw have to push up the whole weight of the spindle, but help it out with the feed lever."

About four cuts down produced a satisfactory thread. The welder's helper had already brought in the seat that had been built up, and one of the machinists had taken it to a lathe to turn it off and chase the new thread.

Old Bill felt the depression that sometimes comes from a hard day's plugging about the shop rise from his shoulders. He knew that the pump would be delivered on time!

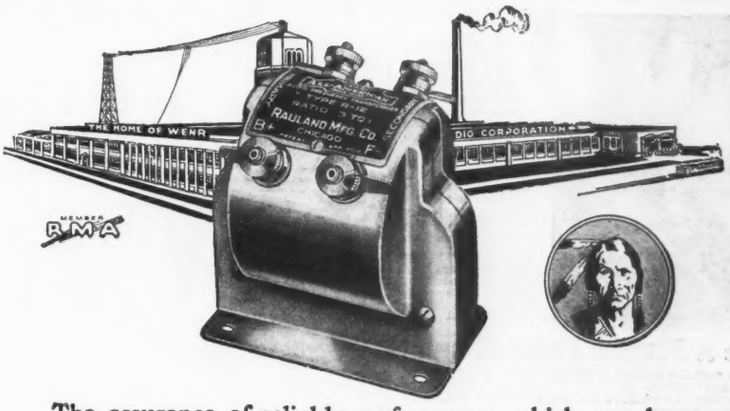
A smile illumined his face as he returned to the magazine.

The fellow who tinkers around the house says the handiest tool in his whole kit is a good husky, keen-knifed pair of Klein's eight inch side cutting pliers.

Your hardware retailer will tell you that they are standard with the professional mechanic.

Mathias Established 1857 KLEIN & Sons Chicago Ill USA

Back of Each Instrument



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The RADIO KEY BOOK—new edition—is a practical handbook for all who wish to enjoy modern radio at its best. Send 10 cents—coin or stamps—for the KEY BOOK.

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Quantity Production reduces our costs. We pass the saving on to you.

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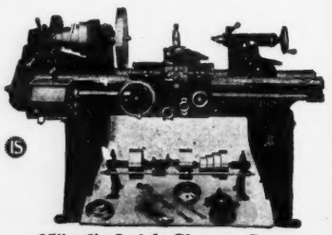

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Adds as rapidly and accurately as a $300.00 machine, yet fits the vest pocket. Easy to operate. 9 column capacity — best constructed portable adding machine made.

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Counts Up to 999,999,999
Total visible at all times. A pull of the finger clears it. Don't carry a pocket full of pencil stubs and scrap paper to do your figuring. Carry a Ve-Po-Ad.

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Be a Finger Print Expert

More men are needed every day. But only trained men are wanted. We will train you at home in your spare time, as we have trained many of America's greatest experts.

Big Money to Experts Big salaries are paid. Rich rewards offered for "wanted" man. Unlimited opportunities for a professional business of your own.

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SEND NO MONEY—Just name and address. Beautiful samples sent you FREE. But act at once. Do not delay. Start right out making big money. Address
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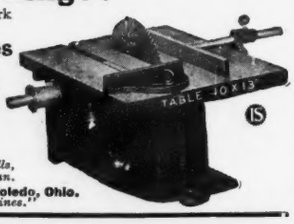
New Improved Band Saw. 14" Wheels. Table tilts full 45 degrees. Saws 6" stock. Handisaws made in 3 sizes. 8" saw cuts 2½" stock. Dadoes 1 ¼" deep x ¼" wide.

Either machine driven by ¼ to ½ H. P. Motor. Portable. Attach to light socket. Unsurpassed values and prices.

Write today for descriptive catalog of Bench Saws, Drills, Jointers, Band Saws and the Boice E-Z-Pay Plan.



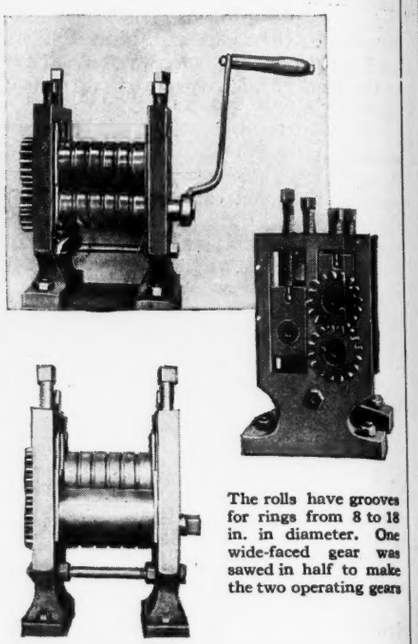
W. B. & J. E. Boice, Dept. P. S. 9-A, Toledo, Ohio.
"World's Largest Makers of Small Bench Machines."

Better Shop Methods

Roller for Reclaiming Railway Air-Brake Expander Rings

TO RECLAIM railway air-brake expander rings, I made the roller illustrated. With it I found that I could reroll the rings for less than half what they cost new. It is possible to roll 700 in eight hours.

The rings, which are used in the brake cylinder of the railway air-brake equipment to hold the packing leather against



The rolls have grooves for rings from 8 to 18 in. in diameter. One wide-faced gear was sawed in half to make the two operating gears

the walls of the cylinder when brakes are applied, become unserviceable by getting out of round. As they are very low priced, any method of truing them up must allow all the work to be done in one operation.

Finally I hit upon the idea of rolling them, but the rolls on the market were too soft to stand up. I had some wide structural steel plates forged to shape in the blacksmith shop and machined to size. Five grooves were provided in each of the tool-steel forming rolls. The idler roll is blank.—ARCHIE SKINNER, Chicago, Ill.

Special Tool Cuts Awkward Holes in Furnace Walls

IN ORDER to install a heating coil in an old hot-air furnace, I had to cut two circular holes in the furnace wall as well as in the outside shell, 6 in. away. It was out of the question to do a neat job with a chisel, so I forged a special drill from an 8-in. piece of ⅜-in. tool steel. After shaping up this steel as illustrated, I drilled a hole into which to insert the centering point. This I had soft soldered in place after the drill had been hardened. As the drill was turned on this centering point, the cutting edge, which was ground like a small chisel, made a clean circular hole very quickly.—HUGH L. COFFMAN, Denver, Colo.

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

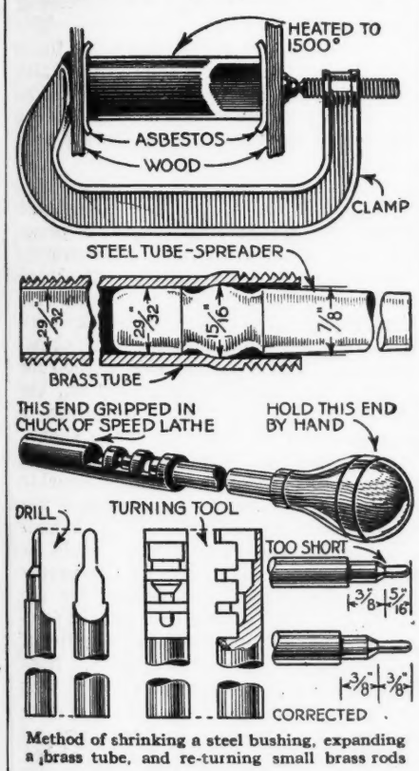
Better Shop Methods

Unusual Ways of Reclaiming Spoiled Machine-Shop Work

By Charles Kugler

SPOILED work in machine-shops runs into millions of dollars annually, yet only a small percentage of it is reclaimed. Few are the shops that do not have to contend with this problem. The mechanic who never spoiled a job is rare indeed. Between the planning and the completion of a job, no matter how skilled the individual worker may be, there is always a chance for misunderstanding and errors.

Doctoring a spoiled job is not always practicable nor even advisable, even in cases where there is no hazard involved other than the reputation of the shop.



Method of shrinking a steel bushing, expanding a brass tube, and re-turning small brass rods

At the same time, a great deal of incorrect work could be rectified so that it would function in every way as well as if made properly in the first place. Every effort to eliminate waste in this direction is worthy of consideration. If the error is the result of wrong specifications or

(Continued on page 118)

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PLANES

Give your work the professional touch

SARGENT PLANES will help *you* —just as they have helped thousands of carpenters in shops and out on building operations everywhere—to get the best from your work. They are tools of the master craftsman, but so moderate in cost that they should be in every home and school workshop. They will soon pay for themselves in improved work and a saving in time. They are so strongly built of finest materials that you may never have to replace them.

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Most good hardware stores sell them. We will send you the Book of Sargent Planes upon request.

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We want men and women in every community to demonstrate and take orders for Comer All-Weather Top Coats and Rain Coats. New offer enables you to earn $200 a week and a Chevrolet Coach. No collecting or delivering. No experience needed. Mail the coupon now for full details.

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Just Out—Amazing Invention—Beacon Lite Spark Plugs. You see the flash of each explosion in the cylinders. Tells which are firing right. Greatest improvement in spark plugs since gas engines were invented. Wonderful gas savers. Agents coining money.

$90 A WEEK

Easy to make with new sure-fire plans. Sells on sight to every auto owner. Phillips, Ont., writes "Sold 2 dozen today, 3 dozen yesterday. Rush 10 dozen." Write for special Free Demonstrator Offer and FREE deal to introduce these wonder spark plugs in your territory. Write quick—today.

CENTRAL PETROLEUM COMPANY
635 Century Building Cleveland, Ohio

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

Two tools that ought to be in every man's tool chest, Vaughan's Vanadium Steel Hammer and a Drop Forged Unbreakable Plane. They're two sturdy tools that will give years of service. Your hardware dealer has a full line.

VAUGHAN & BUSHNELL MANUFACTURING COMPANY
Makers of Fine Tools
2114 Carroll Ave Chicago, Ill. U.S.A.

RAISE YOUR PAY WITH THESE BOOKS

These books will give you an entire course of instruction in your trade in one volume. They will start you on the road to big pay.

Electrical Books

Telephony, Including Automatic Switching, by Smith....450 pp. Leatherette	$2.50
Practical Applied Electricity	$2.00
Wiring Diagrams and Descriptions	$1.50
Armature and Magnet Winding	$1.50
Electric Motors, D. & A.	$1.50

Carpentry Books

Cloth Binding

Modern Carpentry, 2 vols.	$3.00
The Steel Square, 2 vols.	$3.00
Modern Estimator	$1.50
Timber Framing	$2.00
Builder's Architectural Drawing	$2.00
Concretes	$1.50
Practical Bungalows	$1.00
Roof Framing, by Van Gasbeek	$1.50

Automobile Books

Automobile Starting, Lighting and Ignition, by Manly....700 pp.	$3.00
Brookes' Automobile Handbook	$2.00
Ford Motor Car, Truck and Tractor, by Manly....Cloth	$1.50
Automobile Battery, Care and Repair, by Manly....Leatherette	$2.00
Motorcycle Handbook, by Manly	$1.50

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Sheet Metal Workers' Manual	$2.00
Oxy-Acetylene Welding and Cutting....Cloth	$1.25
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Handbook for Millwrights....Cloth	$2.00
Machine Shop Practice....Cloth	$2.00
Mechanical Drawing and Machine Design....Cloth	$2.00

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Check the book or books you want and mail with your remittance. We will send the books you order on the understanding that if they do not prove satisfactory to you in every respect we will refund your remittance.

Popular Science Monthly
250 Fourth Avenue, New York

POPULAR SCIENCE MONTHLY
Gentlemen:
Please send me the books I have checked above, for which I enclose my remittance of $....I am ordering these books on the basis that if I am not satisfied my money will be returned.

NAME.....

ADDRESS.....

.....

Better Shop Methods

Reclaiming Spoiled Work

(*Continued from page 117*)

incorrect dimensions on a drawing furnished by a customer, it may be permissible to suggest a means of saving the job in the customer's interest.

In many cases the reclaiming of a piece of work calls for considerable study and ingenuity and in any event the cost must not be greater than that of producing a new piece, unless time is the most important consideration. The following examples demonstrate what can be done to save work that at first glance seemed to be irredeemable.

Six bushings like the one shown were bored and reamed on a turret lathe. The axis of the turret was not in line with the lathe so that the reamer, which was not in a floating holder, made the hole .010 in. over size. The general opinion was that nothing could be done to save the bushings.

One of the machinists said that he would like to tackle the job, as it was something he had been up against before, so the foreman let him have a try at it. The bushings were placed in a gas furnace and heated to about 1500 deg. A hot bushing then was put quickly in a clamp between two wooden blocks and two sheets of asbestos, as shown. The whole combination was quenched in water. The first bushing quenched shrunk about .015 in. in the hole. In the others a decrease of from .012 to .015 in. was obtained. This was sufficient to allow the holes to be finished with a hand reamer, after which the bushings were turned and faced. The secret of this simple trick is to prevent the water from coming in contact with the hole.

IN ANOTHER instance I once employed a simple means to save a lot of pieces made from brass tubing. The error in this case consisted of cutting the thread under size, the result of the mechanic's having been given a wrong gage to work by. As the inside diameter was not important, it was apparent that if the tube could be expanded about 1/32 in., the thread might be recut. I turned a machine-steel plug of the shape shown. After being pack-hardened, this was driven into the tubing a distance equal to the length of thread. No difficulty was experienced in expanding the outside diameter so that the threads could be finished with a hand die to the proper size. Every piece was passed by the inspector. This simple kink got the foreman of a large screw-machine department out of possibly serious trouble. Incidentally, this is an example of work that was saved with small chance of embarrassment to any one, as there was no sacrifice in the quality of the finished pieces.

Another job I had to reclaim was a lot of brass rods turned on the small end 1/16 in. too short. It should have been 3/8 in. instead of 5/16 in. as shown on the preceding page. The error was not discovered until the rods were assembled into tools and ready to ship.

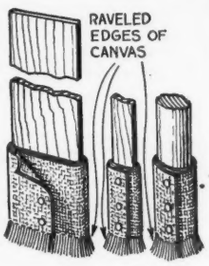
(*Continued on page 119*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 19.

Better Shop Methods

Small Brushes for Shop Use Made Quickly and Cheaply

FOR years we have used emergency brushes made as shown. There are hundreds of times when a mechanic needs a brush for a little job, as for putting a finish on a neglected spot, gluing, shellacking a gasket, and the like. It takes time to hunt up a bristle brush and then perhaps the brush is too large or needs cleaning.



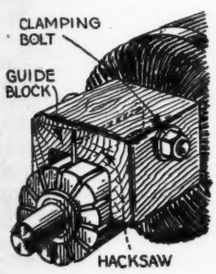
Three styles of brushes

Just take a strip of old awning cloth, ravel it out until the threads are long enough to make a suitable brush, and wrap the cloth three or four times around a strip of veneer from a berry box or a small twig or stick. After use the brush is thrown away.

These simple little brushes have saved me many a dollar, so that I make up a batch at a time and keep them on hand for our automobile mechanics.—JOHN R. DODGE, Normal, Ill.

Undercutting Commutator Mica

MICA between the segments of a motor commutator can be cut down to a uniform depth with the tool illustrated. This is simply a saw blade fixed in a hardwood block, which is made with two guiding edges on one face so as to fit the commutator snugly. A transverse bolt through the block clamps the saw in its slot. The saw is adjusted to protrude just far enough to cut grooves of the desired depth and the block guides it so as to follow each groove exactly. —G. A. LUERS.



Wooden guide for saw

Reclaiming Spoiled Work

(*Continued from page 118*)

I made a form-turning tool as shown, which was used in a speed lathe. The tool was placed in the chuck of the lathe and the rods were inserted into it by hand, and turned back the required 1/16 in. As the over-all length was not important, a decrease of 1/16 in. in the length in no way affected the quality of the tool.

To make the forming tool I first turned up a flat drill or cannon drill as illustrated. The dimensions of this drill corresponded to the finished dimensions of the piece. This was given the proper clearance for cutting and then hardened and tempered. It was used in the ordinary way to form the corresponding shape in the forming tool.

Charge it while you sleep!

Last thing at night—concert over—time to lock up. Radio battery low? Just clip on the Tungar, and plug it in. Or if you connect up the Tungar permanently, *just throw a switch.* Charge the battery while you sleep.

The Tungar is simple — makes no disturbing noise. And the low cost of Tungar recharging cuts battery upkeep to next to nothing. It means top notch performance—clear, full-volumed reception—*all the time!*

The Tungar is a G-E product developed in the great Research Laboratories of General Electric.

The new Tungar charges radio "A" and "B" batteries, and auto batteries.

Two ampere size (East of the Rockies) . . . $18.00

60 cycles—110 volts

Tungar
REG. U. S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Division
General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

"I Made $7000 in One Year"

Sworn Statement by Frank DePries

DePRIES

He further states that he has made $900 in one month's time, $500 in a single day, individual sales of 180, 114 and 105 machines at various times. Mr. DePries has been with our company 8 years. Smith of Minn. reports for one week — 43 hours, 44 calls, 28 sales, and $166.20 profit. Robey, W. Va., quit a job at $175 a month and now makes $500 a month with us.

Approved by Underwriters

Any MAN can sell them~~

Used by the U. S. Gov't., General Motors, Standard Oil, Ford Motor Co., and other big buyers.

AGENTS WANTED

We need more men like these, because the demand for our *Super Fyr-Fyter* is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY
863 Fyr-Fyter Bldg., Dayton, Ohio

WANTED

Men to manufacture Metal Toys and Novelties. Good chance to start your own well-paying business producing such big sellers as Toys, Novelties, Ash Trays, Book-blocks, Souvenirs, Advertising Specialties, Paper Weights, etc. We furnish forms with complete outfit for speedy production. Absolutely no experience or tools necessary; no special place needed. Small investment puts you on road to success. Demand exceeds supply and we assist and co-operate with our manufacturers in selling their products. We put you in touch with the buyers and assure an outlet for your goods. Strictly a business proposition and thorough investigation invited. A splendid opportunity for an enormous and profitable business for ambitious men. No others need apply. Catalog and information mailed on request.

Metal Cast Products Co., 1696 Boston Road, New York

I Made $21.00 In Five Hours

—Writes Peter Werner, Ill. Sell Madison "Better-Made" Shirts for Large Manufacturer Direct to wearer. No capital or experience needed. Many earn $100.00 weekly and bonus.

Write for Free Samples

MADISON SHIRT M'FRS, 505 Broadway, New York

BLANK CARTRIDGE PISTOL

Protection against Burglars, Tramps, & Dogs

PRICES 50c. $1.00 POST-PAID

Well made and effective; modelled on latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. Price 50c. Superior quality $1.00 Postpaid. Blank Cartridges, by express, 50c per 100.

Johnson Smith & Co., Dept. 411 Racine, Wis.

Only $5.69 a month for a few months—easy to own the famous standard WITTE Engine. Uses Kerosene, Gasoline, Distillate or Gas. Equipped with celebrated Troubleproof WICO Magneto. Simplest and cheapest to operate. New device makes starting easy. 50% surplus power. Sizes 2 to 25 H-P—all styles. Sold direct from factory to you on NINETY DAYS' FREE TRIAL. Write today for my new illustrated engine book—sent absolutely Free. No obligation to you.

FREE BIG NEW ENGINE BOOK

WITTE ENGINE WORKS
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Ritemor PRINTED STATIONERY $1.00

200 SHEETS, 100 ENVELOPES

Printed with your own name and address (4 lines or less) in rich dark blue ink. Fine texture *Hammermill Bond* paper, smooth and beautiful. Sheet size 6x7, extra heavy envelope to match. Shipped in attractive box, postpaid. Denver West add 10 per cent. *Remit with order*, money refunded if not fully satisfied. Remember, there is only one "Ritemor", known everywhere and preferred by thousands. Order now.

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PROMPTNESS ASSURED — BEST RESULTS

Send drawing or model for examination and report as to patentability

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In Business 25 Years—Complete Facilities—References.

Write ADAM FISHER MFG. CO.
FISHER MFG. CO. 183-D Enright Av. ST. LOUIS, MO.

Will You Wear This Suit?

Show it to your friends and neighbors as a sample of our fine quality, hand-tailored **All-Wool** Suits, guaranteed $40 values at amazing low price of $23.50, take their orders, keep handsome profit for yourself and send orders to us.

Agents Making BIG MONEY

$3.00 to $5.00 an hour in spare time, $75 to $150 a week for full time. We supply handsome Swatch Line Outfit, large size samples and all latest styles in elegant Leather Case. Positively finest selling outfit ever furnished salesmen. Write for yours at once, pick out your suit and get started making the Big Money right away. Address Dept. 153.

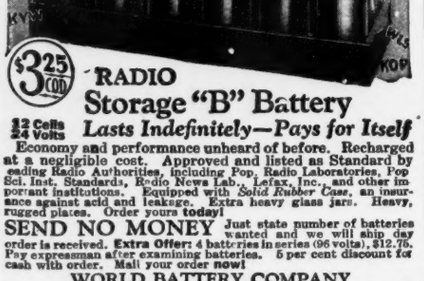
JAMES OLIVER, Inc.
848 W. Adams Street Chicago

Write name and address below and mail at once.

Name.....

St. and No.....R. F. D.....Box.....

Town.....State.....



$3.25 COD

RADIO Storage "B" Battery

12 Cells 24 Volts *Lasts Indefinitely—Pays for Itself*

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other important institutions. Equipped with *Solid Rubber Case*, an insurance against acid and leakage. Extra heavy glass jars. Heavy, rugged plates. Order yours **today!**

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. **Extra Offer:** 4 batteries in series (96 volts), $12.75. Pay expressman after examining batteries. 5 per cent discount for cash with order. Mail your order **now!**

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 80 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $11.85; 120 Amp. $12.85; 140 Amp. $14.00. All equipped with Solid Rubber Case.

World STORAGE BATTERIES FOR RADIO

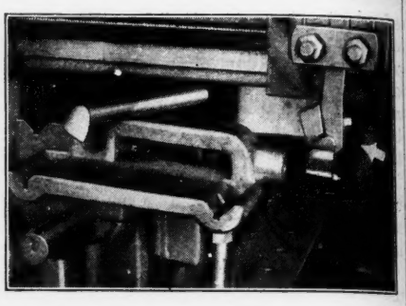
KDKA - WEAF - WGN - WJZ - KHJ - KGO - KFAF - WJY - KOP

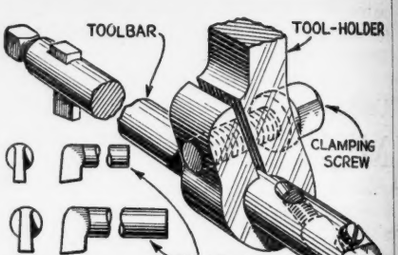
Better Shop Methods

Tool-Holders and Toolbits for Planing, Shaping, and Slotting

FORGED tools for slotting and for cutting keyways in holes often may be replaced profitably by the type of tools illustrated. These tools are more efficient than the forged tool and at the same time considerably cheaper, since only the actual cutter is made of high-priced alloy steel. Cutters are readily made up in stock and may be ground systematically and accurately by the tool grinder.

Cutters of various forms for unusual places may be provided, such as on the





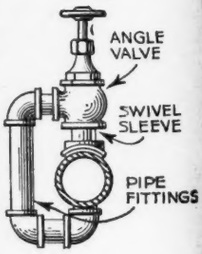
Tool-holder, toolbar and toolbits. The white arrow points to a roughing tool ready for use

planer job illustrated, where a broad-nose tool 1 in. wide is used for finishing the left side of the rectangular slot in the casting. A roughing-out tool is shown gripped in the holder, and the broad-nose finisher is lying on top of the casting to the left of the finished vertical wall of the slot.

The round shank permits the tool-setting to be corrected and allows the use of the cutter in any angular position desired. Another feature is that the shanks or special round toolbars may be made extra long to suit varying lengths and conditions of work.—O. S. MARSHALL.

Emergency Repair for Pipe Line

A BROKEN water, gas, air, or steam pipe may be repaired temporarily by the use of a clamp made as shown from an angle valve, two nipples, two elbows, and a short length of pipe. The pipe is a loose fit, so that turning the valve forces it against the fiber or other packing material used over the hole. These parts later can be returned to stock.—F. N. C.



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The Power in Your Eyes

(Continued from page 25)

of mica, containing no wire, but lined on the inside and outside by strips of lead or aluminum foil. This made a type of condenser, and more favorable results were obtained. Then he submerged the cylinder in a glass vessel containing paraffin oil, so as to do away with any radiant heat effect, and even under these conditions the cylinder moved when the gaze was directed steadily at it.

Mr. Beall says that he never "learned" to train wild animals; that he developed a natural ability. Doctor Russ' experiments make it seem highly probable that this natural ability is in reality the possession of an exceptional amount of electric eye power. They may serve to explain also the marvelous power exerted over other men by the glance of great leaders such as Napoleon, and the demoralizing effect on his ring opponents of the famed "hypnotic eye" of John L. Sullivan.

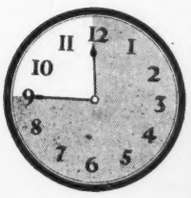
Later experiments made by Doctor Russ have shown that there is a great difference in the intensity of the eye power of various individuals. The average glance at the wire coil produced a movement of 15 degrees. On the other hand, a brilliant actress, a woman of extraordinary personality and charm, was able to turn the indicator 60 degrees—a sixth of a complete circle. A famous flying man, an "ace" in the World War, did as well.

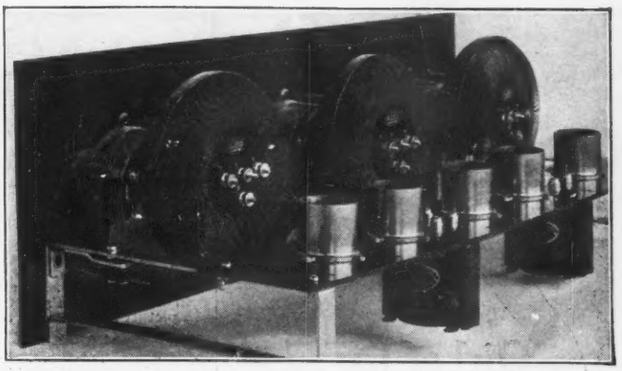
IN MY talk with Mr. Beall he remarked that if ever dangerous animals are allowed to realize their superior strength, the trainer is lost. Men with 25 or 30 years of experience as trainers have been killed by animals they had worked with for years. Why? Doctor Russ' experiments again furnish a possible answer. The gaze of a man who had been warned by his oculist that a cataract was forming on one of his eyes was able to move the indicator only a few degrees. Another man, under 30 but in the early stage of palsy of the spinal nerves, could make no more than a trivial impression on the instrument.

In view of these experiments, is it not quite possible that the sudden disasters that sometimes end the careers of experienced animal trainers are caused by some physical decline that results in a lessening of the electric power of the human eye?

That actual though invisible rays of electricity shoot out from our eyes, exerting influence over men and beasts in proportion to their strength, is a startling conclusion. Perhaps the "electric eye" is not a thoroughly proved fact, but Doctor Russ' experiments, so carefully performed and so conscientiously checked, take it out of the field of superstitious fancy and into the domain of scientific research. This electric quality of the human gaze, if actual and understood, might be made to serve very useful ends in many fields of human endeavor. For more definite conclusions about it we must await the results of the advanced research work of Doctor Russ and other scientists.

Build this phenomenal new radio *in 45 minutes*





The revolutionary Erla Circloid-Five Factory - Bilt Kit —as you receive it.

Price $49.50

Ⓢ

This new type kit is factory assembled. Ready cut, flexible, solderless leads make it ridiculously easy to wire. Amazing new inductance principle brings results hardly thought possible. Send for book, *Better Radio Reception.*

NOW anyone can build the finest of receivers in only a few moments. No more wire bending or soldering. Merely attach a few ready cut, flexible eyeletted leads and the job is done. The finished set is unsurpassed even by the costliest factory-built receiver.

But most amazing is the new inductance principle incorporated in this last word in kits—called the Erla Circloid principle of amplification.

Four vital improvements result from this great discovery, which are not found in ordinary sets.

1. ***Greater Distance:*** Erla * Balloon *Circloids have practically no external field, consequently do not affect adjacent coils or wiring circuits. This enables concentration of proportionately higher amplification in each stage, with materially increased sensitivity and range.

2. ***More Volume:*** Increased radio frequency amplification made possible by Erla Balloon Circloids gives concert volume to distant signals inaudible with receivers of conventional type.

3. ***Increased Selectivity:*** Erla Balloon Circloids have no pick-up quality of their own. Hence only signals flowing in the antenna circuit are amplified. Static is greatly reduced for this reason.

4. ***Improved Tone Quality:*** The self-enclosed field of Erla Balloon Circloids eliminates stray feed-backs between coils and consequently does away with mushing of signals and distortion due to this cause. Tone is crystal clear and perfectly lifelike.

Write for free information on kit—also book

See how 45 minutes of fun will give you one of the very finest sets known to radio science. Easy as A-B-C to finish. Examine it at any Erla dealer's, or send the coupon for full information, illustrations and diagrams *free.* Also ask for remarkable new book, "Better Radio Reception," describing the sensational new Circloid principle. Enclose 10c for mailing and postage on book.

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ERLA

☐ Send me free information on kit. ☐ Enclose 10c for postage for book, "Better Radio Reception."

This sign identifies authorized Erla distributors. All are equipped to give complete radio service.

Name .....

Address .....

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Dealers *Exclusive franchises are available to high class dealers in localities still open. Write or wire immediately.*

Darche "CALL-ME" Electric ALARM and LIGHT CLOCK

Will ring until you get up and STOP it. No home complete without one. Can be used as an "alarm clock" and "mantel clock". Get one with just a little effort on your part —NO MONEY NEEDED. OUR OFFER TELLS YOU HOW. Agents, here is a big money-maker, no competition, sells on sight. A good punch board proposition. Write today for our descriptive literature. An ideal GIFT for any occasion. Mahogany finish. Size 10 1/2x8 1/2x4.

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643 Washington Blvd., Chicago, Ill.

Learn to Mount Birds

Learn at home to mount birds, animals, game heads; tan furs, make rugs and robes. Complete lessons. Easily and quickly learned by men, boys and women.

FREE Write for Free Taxidermy Book. Tells all about it. Every sportsman, trapper and Nature lover should know this wonderful fascinating art. Save your trophies. Big profits. Success guaranteed. 75,000 graduates. Investigate. Write for Free Book.

Northwestern School of Taxidermy 1786 Elwood Bldg., Omaha, Neb.

WELDING

Mr. Mechanic, be in demand! Expert welding is in demand in every part of the world. Earn top wages or go into business for yourself. We train you at Home, in your Shop, or on the Job. **"Kerr's Training Course for Welders"** is a thorough course in practical experience covering all metals. It trains you in WHAT TO DO, WHY IT IS DONE, and HOW TO DO IT. Write at once for information (state if you own or have access to a welding outfit).
Kerr's Welding School, Box 1313, Los Angeles, California. (1)

BURN YOUR NAME ON TOOLS WITH THE ARKOGRAF

Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. Complete Outfit $3.50 Prepaid Anywhere. Interesting illustrated circular free. Write today. Agents wanted.

ARKOGRAF PEN CO.
1171-A East Stark St., Portland, Oregon

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WURLITZER

Girl of 13 Makes $75.00 a Week!

Alice Higgie, a 13-year old Chicago girl, made $75.00 a week in vaudeville last summer. Her musical act is constantly in demand for clubs, lodges, hotels, radio studios and private entertainments. For a 15 minute act she receives $15.00—*a dollar a minute!* Read what she says—"Playing a musical instrument is lots of fun. I wish everybody knew how easy it is and how quickly you can learn, especially with Wurlitzer instruments—they are so easy to play."—Alice Higgie.

New Offer

Learning to Play Made Easy

Free We now furnish free with every Wurlitzer instrument a Special Scholarship in a nationally famous school of music. This school has taught thousands to play by a special home study method. Many of its graduates are successful professional musicians. Whether you want to play for pleasure or for profit, choose your favorite instrument and send for this New Offer now! Use the coupon below. **Free Trial** in your own home on any Wurlitzer instrument. Easy payments if desired.

Send for **Free Book**

Illustrates and describes every known musical instrument—more than 3000 articles, many of them shown in full colors. All genuine Wurlitzer instruments—buy direct from Wurlitzer and save money. Special offers on complete outfits.

We also give you our Free Trial, Easy Payment plan and special Free Scholarship Offer. No obligation.

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The Rudolph Wurlitzer Co., Dept. 1786
117 E. 4th St. Cincinnati 329 S. Wabash Ave. Chicago
120 W. 42nd St. New York 250 Stockton St. San Francisco

Send me your Free Book on musical instruments. Also your Free Trial, Easy Payment plan and special Free Scholarship Offer. No obligation.

*Name*_____

*Address*_____

*City*_____ *State*_____

*Instrument*_____

WURLITZER

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Here Are the Rules in
Our Great $10,000 Contest

This Month's "What's Wrong" Pictures Appear on Pages 32 and 33

1. Every month for four months, beginning in the June issue, POPULAR SCIENCE MONTHLY is printing a set of pictures of John and Mary Newlywed. Each of these pictures shows John or Mary doing some simple "job about the home" in an incorrect way. And, in addition, there is a deliberate error in the drawing of each picture. You are to tell us what two things are wrong in each picture and why they are wrong.

2. There are four complete monthly contests, each of eight pictures. The first was in the June issue, a second was in the July issue, the third in the August issue, and the last appears in this issue on pages 31, 32, and 33. In addition, there will be a Grand Prize Contest covering all of the 32 pictures printed in the four months of the contest.

3. POPULAR SCIENCE MONTHLY is awarding $10,000 in 580 cash prizes for the best answers submitted in the contest.

The cash prizes in each of the four monthly contests are as follows:

First Prize	$500
Second Prize	$100
Third Prize	$50
Next 5 Prizes, $10 each	$50
Next 60 Prizes, $5 each	$300
Monthly total	$1000
Four months' total	$4000

4. In addition, cash prizes in the Grand Contest will be paid as follows:

First Prize	$2500
Second Prize	$1000
Third Prize	$500
Next 5 Prizes, $50 each	$250
Next 50 Prizes, $10 each	$500
Next 250 Prizes, $5 each	$1250
Total Grand Prizes	$6000
Total Prizes	$10,000

HOW TO COMPETE

5. In connection with each picture these questions must be answered: "What job is being performed improperly in this picture and how should it be done correctly? And (2) What error has the artist made in drawing the picture and why is it wrong?" A list of errors—two for each picture—is in the custody of the judges and will be used as a basis for the selection of the prize-winners. Prizes in all of the contests will be awarded to those persons who answer best the questions for the largest number of the pictures. It is provided, however, that as between contestants having the same number of correct solutions the selection of winners will be based upon (1) accuracy; (2) clearness; and (3) skill of presentation. In cases of ties, a duplicate award will be given to each tying contestant.

6. Answers to each set of eight pictures must be received not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to insure consideration in this month's contest, answers to the eight pictures in this issue, published August 10, must reach the office of POPULAR SCIENCE MONTHLY not later than September 30. Pictures received by this date will be entered automatically in the Grand Prize Contest also. Contestants, however, may enter for the Grand Prize Contest any time before September 30, without having entered a monthly contest. Contestants also may hold the answers to all pictures until they have a complete set of 32 before submitting the answers, it being stipulated, however, that no such entry will be received after September 30.

WHEN SUBMITTING ANSWERS

7. Contestants may submit as many answers as they wish to pictures in either the monthly contests or in the Grand Prize Contest, but each must be submitted in good faith. Answers may be submitted on any kind of paper, but the writing must be legible and on one side of the paper only. Each picture will be numbered plainly and contestants must attach to their answers either the corresponding picture cut from the magazine or the number of the picture. The winning of one or more monthly prizes will not bar the winner from winning a Grand Prize, if he should submit answers.

8. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each entry. An entry with insufficient postage will not be received. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be returned.

9. Prize-winners in this month's contest will be announced in the February issue of POPULAR SCIENCE MONTHLY, published January 10. The names of the winners of Grand Prizes will be announced and the correct solutions published as soon as possible after the close of the final month's contest.

10. You pay nothing. Just prove your knowledge and observation. You need not purchase POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or examine one at any of the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. These contests are open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families. The officials of the Popular Science Institute of Standards will act as judges and their decision will be final. Acceptance of these rules is an express condition of each entry.

See pages 32 and 33 of this issue for the final set of pictures in this remarkable contest.

IF YOU have mislaid the June, July, and August issues of POPULAR SCIENCE MONTHLY containing the first three sets of Contest pictures, and if your newsdealer cannot supply you, copies of these issues are available for your free use at the public libraries or at the offices of this magazine. Or, if you prefer, you can obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Ave., New York City

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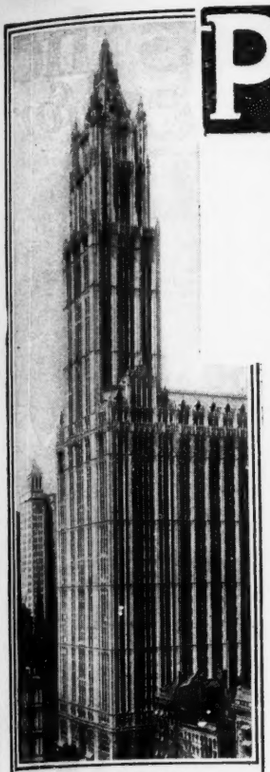

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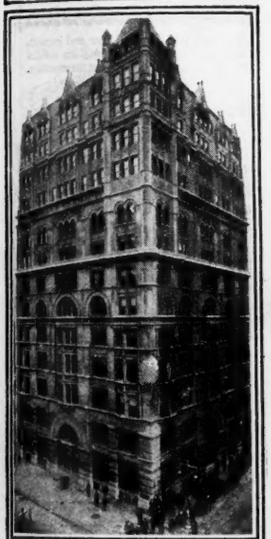

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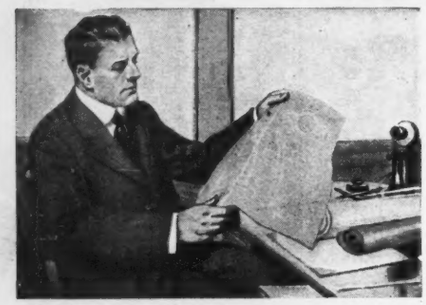

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Cracks in the Earth Menace American Cities

(*Continued from page 22*)

ually are becoming larger, while the continents are being compressed so that the land areas are rising as the sea front retreats. The contours of the United States show this.

It is believed that the shores of the American continent once were connected with Africa, or at least were separated only by a narrow strait. Since the Atlantic has been enlarged, the plateaus in the western states and the mountain ranges all have been raised considerably. These movements always have been connected with volcanic activities. The land areas have been faulted by condensational waves caused by the falling in of large areas of the sea floor; by gravitational waves caused by landslides, near faults in the rock masses, and by stationary waves set up by local deformations caused by landslides and similar movements. All of these have been in operation along the Pacific coast earthquake zone.

Arizona, Kansas, Oklahoma, and Arkansas are the seats of frequent earthquake shocks. Quakes, of more or less severity, are felt in those states annually. The whole valley of the Mississippi is undoubtedly situated on a line of faults, constituting an earthquake zone. Alabama and Tennessee have earthquake records showing that the earth's crust in those states is not strong. The Virginias are on a similar line of weakness and this line can be traced along the Atlantic coast to Canada and Newfoundland. There is a pronounced fault in the sea-bed off the coast of Maine which appears to be connected with faults running past New York.

The St. Lawrence, the Great Lakes, and a series of lakes and waterways running through Manitoba, Alberta, and Saskatchewan and through the Mackenzie Valley to the Arctic—these form a great line of faulting along which most of the earthquakes experienced in North America are felt.

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"It's a High Pressure Job"

(Continued from page 37)

not half the risk those chaps up there are takin' every day. If it was a risky job, how do you suppose they put them two big vehicle tunnels under the Hudson River without losin' a man? Twelve hundred sandhogs worked on that job, an' I was one o' them. Never less than 300 of us at work at once, an' the only two men killed on the job was not sandhogs. One fell down a shaft an' the other got caught in the works of a pump. How many big buildings kill as few ironworkers as that?

"SURE, there's risks, but nothing like what they used to be. When they started the very first try at a tunnel under the Hudson, more'n 50 years ago, the tunnel caved an' 20 men was drowned. That was before they knew how to work the air like they do now.

"Y' see, down in the caisson or out at the tunnel headin', the trick is to keep the cuttin' edges covered with the stuff you're workin' in—mud or clay or whatever it is. If your caisson is level an' your air pressure is right, you don't have no trouble. You've got to have air enough to equalize the water pressure and not enough to blow out the mud. You're diggin' from the middle toward the edges all the time, and shovin' the caisson down or the tunnel headin' across as fast as you can get to the edges. Now, if your mud blows out, you've got a blowout, and the air alone can't hold the water back, unless you can get more pressure in a big hurry, an' you can't always do that.

"There's always plenty of bags of hay and bags of clay handy, to plug up any hole where the air is escapin'. You can tell by the sound when the leak begins. An' sometimes, when there ain't enough of that sort of stuff to plug the hole, there's other ways. I mind me once—it was in the Pennsylvania tunnel—when Red Kelly, that was workin' alongside o' me, sat in a blowhole to stop it while we got up the hay bags! It's a good thing most sandhogs ain't skinny.

"THERE ain't much danger if the boss keeps his head. There was a blowout one night in the Manhattan Bridge caisson. There was eight of us inside, workin' in about 35 pounds of air, pretty near 80 feet down; Jimmy Durkin, Jimmy Appleby, an' myself, an' five Swedes. The air chamber was about 10 feet above our heads, an' there was a ladder to the shaft openin'. The shaft would only take in one man at a time. One side of the caisson rested on loose silt, an' needed watchin' all the time.

"Well, we was near the end o' the shift when one o' the Swedes hollered, 'Look at dat!' We looked, an' the silt was crumblin'. Next we knew, it blew out like an explosion an' the water rushed in. Four o' them Swedes made a rush for the ladder, an' we might all have been drowned if the other Swede hadn't picked up a pick handle and whacked 'em over the head. Then we got out, one at a time, with water up to our waists before the last one went up the ladder.

(Continued on page 126)

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"It's a High Pressure Job"

(*Continued from page 125*)

"If the pumps don't stop there'll always be air enough to breathe if you can keep your head above water. Jimmy Sullivan, that I was tellin' you about, told me of a blowout when they was buildin' the Forth bridge, in Scotland. Him an' the other miners was trapped an' the air-lock door jammed. They had just five inches of space between the water and the floor of the lock, just enough to keep their noses clear while they hung on an' waited for help.

"You just got to remember that the water'll only rise so high if all the edges are under water, like when you put a tumbler upside down into a dish of water. One night, in the Long Island tunnel, there was a blowout an' when the men got into the lock there was one missin'. It looked like he was a goner, but when they got the hole plugged—they had to send a diver down to do it—an' pumped the water out, there he was. He'd found a place up at the top o' the tunnel where he could hang on, an' he'd hung on.

"TUNNEL work is more ticklish than caisson work, to my thinkin'. The pressures ain't so high, but there's more danger of a blowout. In a caisson, if it's level, the water pressure's the same all around the edges; but in a tunnel it's higher at the bottom than at the top. You can see that, can't you? Take the vehicle tunnel. That's nearly 30 feet from top to bottom. That means the pressure at the bottom is some 13 pounds more'n it is at the top. Now, you've got to have air enough to equalize that bottom pressure, an' overhead you've got only a thin layer of mud between you an' the river. There's where the danger of blowouts comes. Where the bottom of the river's soft, they put down a clay blanket, 10 or 20 feet thick, an' dredge it out afterwards, to hold the air in an' the water out, but close inshore an' crossin' a shallow channel they can't always do that.

"That's how the funniest accident that ever happened to a sandhog came about. They was puttin' the first subway tunnel across from Manhattan to Brooklyn, an' the Brooklyn end was just a little ways out from the pierhead line, at Joralemon Street. It was all soft mud, with piles stickin' down through it, an' one day she blew out with a bang.

"ALL the gang that was workin' in the headin' made the air lock but one, when the water rushed in. Dick Creedon was missin', an' they was a solemn gang that filed out o' the air lock to report to the super. Creedon's side partner, Jimmy O'Connor, had been killed in an accident in the tunnel only a few days before, an' now Dick was gone.

"But when they got to the super's office, there was Dick Creedon, huggin' the stove! Some of 'em thought first it was Dick's ghost. What happened was this:

"The air had caught Dick and blown him right through the river bottom. I was talkin' a while ago about a sandhog havin' no place to fall to. Well, there is

(*Continued on page 127*)

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"It's a High Pressure Job"

(*Continued from page 126*)

one way he can fall, an' that's up. That's the way Dick Creedon fell, up.

"Right up through the mud, 10 feet of it, and 30 feet of water, an' he kept on goin'. I didn't see it, but I've heard him tell about it, many's the time. The water squirted up like a fountain, 10 feet or so above the surface, with Dick balanced on top of it like one o' these balls you see in a shootin' gallery, whirlin' around an' yellin' at the top of his voice. Then he fell off the fountain an' into the East River, an' a boatman picked him up.

"I don't know where Dick is now. Last I heard he was fired off a job in Buffalo because the newspapers printed that story about him, an' he had to spend so much time bein' a hero he didn't have no time to work. But he wasn't the only one that had the same experience. Paddy Egan was blown up through the Thames the same way, on the Blackwall tunnel job. I heard of another that was caught the same way, in one o' the East River jobs. An' many's the time a sandhog has been jammed up against the roof of the tunnel an' held there by the air, in a blowout.

"NO, IT ain't the water I'm most afraid of; it's fire. Everything burns so fast under the compressed air. There's always a high pressure water hose handy, but there's just as likely as not to be dynamite or giant powder in the tunnel or caisson. That happened in the Pennsylvania tunnel, when one o' the watchmen lit a cigarette too close to a bale of hay. It took some courage to go in there with the hose and douse that fire, with half a ton of dynamite in the air lock, but it was a gang of sandhogs that done it.

"It ain't a bad job, as I was tellin' you. You get a chance to travel an' see the world, for there ain't so many experienced sandhogs an' we go from one job to another—from one country to another, for that matter. I was workin' in the power tunnels up in the mountains near Mexico City when they had that last revolution down there, the time Carranza was killed. That was right near where we was workin', an' the revolutionists tried to blow up the tunnels. They did blow up a couple of 'em."

Paddy Ryan spat into the West Street gutter again and once more cocked his eye aloft.

"There's a lot in the paper, now, about this evolution business," he said, ruminatively. "I was thinkin', if them lads up there is descended from mor'keys, then one o' my granddaddies must 'a' been a mole."

PIECES of porcelain containing microscopic specks of gold were recently given to Dr. George F. Kunz, a mineralogist of New York City, by Dr. H. Nagaoka, of Tokio. They were fragments of the flask in which the Japanese scientist claims to have changed mercury into gold by disintegrating atoms of quicksilver in a tremendously powerful electric field. In more than 200 experiments, he declared, this method of changing mercury into gold was successful.

Make $15 a Day Wearing These Shirts

Experienced salesmen, agents, beginners, spare time workers, here is an amazing opportunity to make $10 to $15 a day, with a proposition that sells itself. A sure-fire seller. No expensive outfit needed. You collect your commission in advance.

Agents, Salesmen, Spare Time Workers

At direct from factory prices you can sell these wonderful shirts in silk, linen, madras at 50% less than store prices. We give you a wonderful line of samples—you simply take the orders, collect your commission—we deliver and collect.

Big Money The First Day

Every man is a prospect for these shirts. You can go into offices, factories, garages, etc., and clean up $10 to $20 in an hour's time. Fred Ermankorb made $14 in one afternoon spare time. Frank Henry made $25 in one day. An Ohio man writes "This is the biggest whirlwind seller I have ever run across in my ten years of experience as a salesman." Scores of men write like that. No matter if you never before tried selling, you can win out with these wonderful shirts. As an amazing sideline they can't be beat. Scores of representatives write like this. No matter what your experience, you can earn big money taking orders for these shirts.

Write Quick For Free Outfit Offer

Let us tell you how you can get a free outfit and free territory. No obligation. Simply fill out and mail the coupon below. But don't lose $10 a day by delaying. Write to

Charles Hope, **FASHION WEAR SHIRT CO.**
1200-20 Jackson St., Dept. L-171, Cincinnati, Ohio

Fashion Wear Shirt Company
1200-20 Jackson St., Dept. L-171 Cincinnati, Ohio
Gentlemen: Send me at once full details of your free territory and free sample case offer. This does not obligate me.
Name .....
Address .....
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FREE FORD Offered to Agents

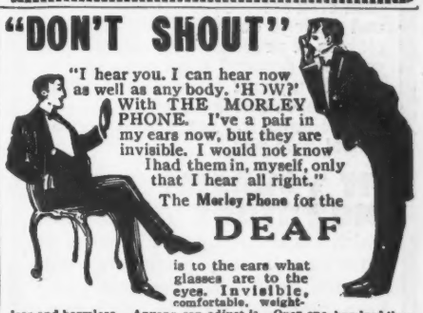
Will you accept a straightforward business proposition that will pay you $9 to $14 a day *from the start* and give you a Ford car **FREE** to help you in your work? I mean just that. I don't want you to invest any money or risk anything. I'll take all your time, or just your spare time if you prefer. Even without giving up your present work, I can show you how to

Make $50 to $100 a Week

I want men and women agents *now* to take orders for the famous Zanol Line of Pure Food Products, Flavors, Toilet Preparations, Perfumes, Soaps, etc. 350 Different articles. Sure-fire sellers in every home. Best money-making offer you ever read. Remember—**FREE** Ford Car. Write for details.

ALBERT MILLS
1362 American Bldg.
Write Quick Cincinnati Ohio

"DON'T SHOUT"



"I hear you. I can hear now as well as any body. 'HOW?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The Morley Phone for the **DEAF**

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

$47 PROFIT IN ONE HOUR

NEW KIND of Trouble Lamp

New kind of electric auto trouble lamp sticks to iron or steel—at any angle—under the hood—under the fender—on the windshield—leaving both hands free to work. Reaches any part of car. Throws clear beam of light 250 feet. A portable trouble lamp—a powerful spotlight—a convenient camplight. Out-performs trouble lamps costing $7.50 and up.

STICKS TO IRON OR STEEL

$1 a Minute for Agents

Hundreds are cleaning up. Wilson sold 56 Stick-a-lites in one hour and 30 minutes—$70.00 profit or almost $1.00 a minute. A school boy in Indiana sold 35 in one afternoon. Toffer sells 800 in one month. Dawes makes $30 a day. Merrill sells 500 to 1000 a month. Clark has standing order for 1000 a month.

Stick-a-lite demonstrates on any car in one minute. Spectacular demonstration is amazing. 8 out of 10 motorists buy. You have 10,000,000 prospects. Don't waste any more time on high-priced slow-sellers. $10,000 a year is waiting for you with the low-priced, fast-selling Stick-a-lite.

Send $2.00 deposit for demonstrator and start right out making $10 to $30 a day—days or evenings. Your money refunded if demonstrator is returned in 30 days. If you prefer, send no money—only name and address for details. **Hurry for big touring season.**

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Dept. 4-K, 1800 Grace Street, CHICAGO, ILLINOIS

FREE!

To Each Purchaser of a WORLD 6 V. Auto or Radio BATTERY

12-Cell—24-Volt Storage 'B' Battery

Positively given **free** with each purchase of a WORLD "A" Storage Battery. You must send this ad with your order. WORLD Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with *Solid Rubber Case*, an insurance against acid and leakage. You save 50 per cent and get a

2-Year Guarantee Bond in Writing

WORLD Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

Solid Rubber Case Radio Batteries

6-Volt, 100-Amperes	$11.25
6-Volt, 120-Amperes	13.25
6-Volt, 140-Amperes	14.00

Solid Rubber Case Auto Batteries

6-Volt, 11-Plate	$11.25
6-Volt, 13-Plate	13.25
12-Volt, 7-Plate	16.00

Send No Money Just state battery wanted and we will ship day order is received, by Express C. O. D., subject to your examination on arrival. **FREE** "B" Battery included. **Extra Offer:** 5 per cent discount for cash in full with order. Buy now and get a guaranteed battery at 50 per cent saving to you.

Approved and Listed as Standard by Leading Authorities including Radio News Laboratories, Popular Science Institute of Standards, Popular Radio Laboratories, Radio Broadcast Laboratories, Radio in the Home, and Lefax, Inc.

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 7 CHICAGO, ILL.

World STORAGE BATTERIES For AUTO and RADIO

KDKA · WEAF · WGN · WJZ · KYW · KGO · WEAF · WJZ · WGN

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HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

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Dept. H-675
Drexel Ave. and 58th St., Chicago

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Send me full information on the subject checked and how you will help me win success.

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.....Building Contractor	.....Lawyer
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.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Wireless Radio
.....Vocational Guidance	.....Undecided

Name.....

Address.....

Birth of the Airplane

(*Continued from page 29*)

sections, and joining these on the machine.

"He's making a tent," thought the passer-by; "fishing trip down river, I guess."

The brothers built a shed camp de luxe for the second season at Kitty Hawk. As before, Orville officiated as chef and in this domestic field he fairly rivaled his brother at the sewing-machine. Orville put mathematics into his kitchen. The canned goods stood on their shelves in the select order of soldiers at dress parade, The eggs were in a rack, visible and countable. There was a gasoline cook-stove.

Unfortunately, this luxury and efficiency were somewhat blighted by hosts of mosquitoes. They were foiled only by smudges that choked the experimenters. Another vexation had to do with the division of labor in dish-washing. There was a camp mate, not Wilbur, who left all of this chore to the cook, keeping the latter busy in the kitchen to the neglect of his aerial activity.

OCTAVE CHANUTE visited the camp, saw the brothers' second-year tryouts and complimented them, saying they were ahead of the world in the gliding art. But they, without admitting it to any one, were deeply discouraged. They knew their machine was no improvement on the first one; in fact, it behaved worse. They had more evidence that the classic air tables were incorrect. The mystery of the air seemed insoluble. At this time Wilbur agreed with the pessimism of Prof. Simon Newcomb as to the possibility of the airplane, and even went further than that eminent astronomer by saying:

"Man won't be flying for a thousand years!"

Wilbur, in his depressed mood, was only exaggerating by 998 years.

Skeeters, heat, no ice, liquid butter, spoiled beefsteak, and a cantankerous glider—you can understand how the brothers felt.

For an address to be made by him that fall before a scientific group in Chicago, Wilbur included criticism of the classic air tables. Meanwhile, at home, Orville rigged an air tunnel with a fan driven by a homemade two-cylinder gas engine. He found the classic figures right! He let Wilbur know in a hurry and the latter toned down his criticism, lest he should mislead the distinguished scientists of Chicago. The scrupulous brothers were planning more censorship of the address in its printed form, when they found they were right in the first place and really had nothing to retract! Orville only had verified with his air tunnel a few of the old figures and these few had chanced to be about right, while the majority were away off.

SAVANTS had spent vast sums in the effort to measure air pressure. The Wrights now succeeded with an outfit that cost about 15 dollars. Their fan was on an emery-wheel shaft, their tunnel was of wood, 16 inches square and eight feet

(*Continued on page 129*)

Easiest of all instruments to play and one of the most beautiful. Three first lessons sent free give you a quick easy start. In a few weeks you can be playing popular tunes. You can take your place in a band or orchestra in a few days, if you so desire. Most popular instrument for dance orchestras, home entertainments, church, lodge and school. A Saxophone player is always popular socially and has many opportunities to earn money.

Six Days' trial and easy payments arranged.

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Shows all Buescher models, gives lesson chart; also pictures of famous professionals and orchestras. Send your name for a copy. Mention any other instrument in which you may be interested. No obligation. Write today.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
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POPULAR SCIENCE MONTHLY
250 4th AVENUE, NEW YORK

ONE DAY BATTERY CHARGING PAYS BIG
New HB One Day Battery starts you making big money recharging auto and radio batteries. Only $35 cash brings complete HB One Day Battery Charging Outfit. Easy payments. No experience needed. Lowest-Priced outfit on the market. 30 days' trial on money back guarantee. Write for free bulletin.
HOBART BROS. CO.,
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YOU CAN CLEAR $150 to $300 MONTHLY

Start a Movie Show
SMALL CAPITAL STARTS YOU
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Drive This Beautiful Kaceabout Instead of Your OLD FORD
Choice of Five Colors; Fits on the Bullet Nose Radiator Shell. Send for 1925 Free Catalog of New Auto Accessories, Bodies and Speed Equipment. Direct from Factory.
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Nothing less than 21 Ruby and Sapphire jewels is good enough for Burlington masterpiece.
Quality and Style
Adjusted to the second—temperature—isochronism—positions. 25 year Gold Strata Case. In 100 designs. $1 down. Balance in small monthly payments.
Send for free book.
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19th Street and Marshall Blvd.
Dept. 13-86 Chicago, Illinois

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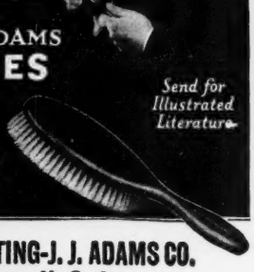
How Good The Bristles Feel!

The first thing you notice about a WHITING-ADAMS BRUSH is *how good the bristles feel*, How strong and springy they are! Then you notice what a clean-cut, perfectly-balanced, and "usable" article the whole brush is. Ask your dealer to show you one.

WHITING-ADAMS
BRUSHES

Send for Illustrated Literature

Making a Brush to Last a Lifetime is a Lifetime Job



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Brush Manufacturers for Over 116 Years and the Largest in the World

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The fine, clear tone and volume of the Kellogg Symphony Reproducer is due to the Kellogg unit with the magnetic diaphragm control.

This exclusive Kellogg principle has produced wonders in the accurate reproduction of voice and music; piano music is unusually fine, the lowest tones of the saxophone to the highest of the violin are as clear as a bell, the soprano voice can really be admired.

Observe the rigid construction of this unit, the exactness of every detail, the size of the magnets. The *unit* is *the* reason.

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With every Kellogg radio part. Use — Is The Test.

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Free

Leatherette Carrying Case Free with Big 3 Foot Wonder Telescope. 5 sections. Brass bound. Powerful lenses. See people and objects miles away as if they were close. See moon and stars as never before. boy arrive at school 2 miles away." — Mrs. Useful and entertaining. "Could tell color of aeroplane 4 miles away." — Mrs. Horn. "Read numbers on freight cars mile away." — Yarbough. "Watch my —A. C. Palmer. Thousands pleased. On arrival of Big 3 ft. Wonder Telescope with FREE Case and Strap, deposit with Postman only $1.85 plus few pennies postage. Satisfaction guaranteed or deposit returned. Order Now.

Send No Money

FERRY & CO., Dept. C-1786, 3224 N. Halsted St., Chicago

Birth of the Airplane

(Continued from page 128)

long. Bits of old hacksaw blades and other junk lying round their shop contributed to the make-up of the testing devices. The air tables that they made in the winter of 1901-2 were applied in all their later construction of aerial vehicles.

If we should estimate the first-found warping principle as one-quarter of the flying secret, we may give 50 per cent of the credit to the aerodynamic research of the Wrights. The final 25-per-cent element will be told of as it came, last.

AGAIN Wilbur toiled at the sewing-machine in the back yard of the Dayton home. A new glider, third model, embodying the newly discovered laws of air pressure, was taken to Kitty Hawk in the late summer of 1902. Rather, the parts were taken, and the machine assembled in camp. Amid scientific observation in his diary, Orville found time to record the life and death history of a mouse that invaded his kitchen. The brothers were never too busy to notice everything about them. A mouse, a razorback pig in camp, the antics of children, pleased them. The quiet young men laughed quietly at many things, including their own mishaps. Rarely if ever did they lose their even, good temper.

The new glider, 305 square feet in wing area and weighing 116 pounds, had its virtues and also some alarming faults. The operator, who lay on his stomach as usual, clutching the controls, had to shimmy quickly to shift his weight and avoid a wreck. There was peril despite plenty of sand to fall on. The brothers knew that Lilienthal and Pilcher had been killed by falling from heights no more than that of a shade tree. At this time Orville did take a drop from about 25 feet up, which partly smashed the glider.

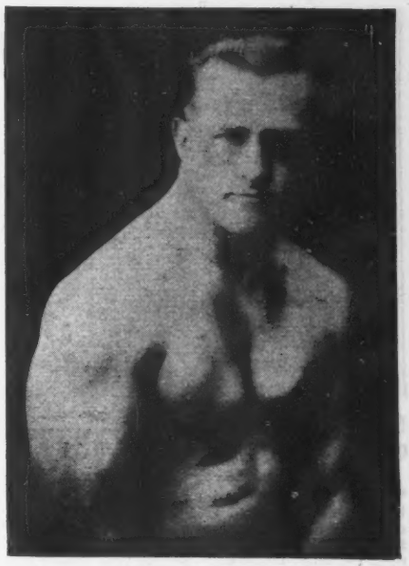
A vertical tail was a new feature of this year's machine. That tail—what was wrong with it? Somehow it did not act as it should. It was rigid, you know. Now some one may chortle an easy answer: Look at all nature. Is a dog's tail rigid, or does it wag? But the flying machine would not have gone far if it had been based on zoology. Too many dreamers copied bird shapes.

HOWEVER all that may be, the fact is that on the night of October 2, 1902, Orville could not sleep. Doubtless it was stuffy among the ceiling beams of the camp shed where he had slung a bed of canvas. A great thought came to him. Let that tail be movable! Although he did not know it that night, as he moved restlessly on the canvas, the invention of the airplane was in effect completed. This was the solution of the last 25 per cent of the problem of air conquest.

Orville did have in mind the object of the movable vertical tail, or rudder. It was to counteract the speed of the high or turned-up wing, and thus aid in the maintenance of sidewise balance. A rudder it was, but not to steer with; its job being to keep equilibrium.

The minds of the brothers were geared in beautiful harmony. As Wilbur

(Continued on page 130)



Earle E. Liederman
The Muscle Builder
Author of "Muscle Building," "Science of Wrestling," "Secrets of Strength," "Here's Health," etc.

MUSHY MUSCLES

When you looked in the mirror this morning, did an imitation of a real man stare you in the face? Chest hollow as a bent mud-guard? Shoulders stooped like a tired old hack horse? Arms like ropes with knots on the end? Neck scrawny as an old crow's? Legs thin as pipe-stems? Muscles soft and flabby? How can you expect to amount to anything if your body is like something the cat dragged in? Mushy muscles—

They Are My Meat

as thousands upon thousands of my pupils will tell you. I take them as they come, weak and flabby. Then I start working! I make your muscles hard as steel. I make your chest big and deep. I give you legs and arms that fill your clothes. Your friends won't know you. I fill you with pep and ambition. When you wake up in the morning, you spring out of bed full of fire and pep. "Bring on your wild cats" is the way you feel. You are ready for a full day's work. You just thrill with vitality.

I Am the Muscle Builder

That's what they call me. Why? Because I take the mush out of muscles! When you think of muscle, think of me! I build strong bodies. Just any kind of exercise won't do. A lot of other fellows thought they could do it themselves. They soon found they were wrong. This is my job. I've studied it. I've watched my pupils develop. I know it's good. In fact, I don't promise results. I guarantee them. In thirty days I will put one full inch of muscles on your arm. I will put two inches on your chest at the same time. But that's just a starter to show what I can do. I'll put muscle up and down your back. I'll build a wall of armor around your bread-basket that will stop a battering ram! I'll strengthen every muscle in and around your vital organs! I'll make a he-man, up-and-at-em-fellow out of you. Sounds good, eh? You're darn right it's good. It's wonderful. Remember, I guarantee it. Come on. Let's get going right now. Don't lose a minute.

Send for My New Book

"MUSCULAR DEVELOPMENT" It is FREE

It contains forty-five full page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings. Imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send to-day—right now, before you turn this page.

EARLE E. LIEDERMAN
Dept. 1309 305 Broadway New York City

EARLE E. LIEDERMAN
Dept. 1309, 305 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name.....

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City..... State.....

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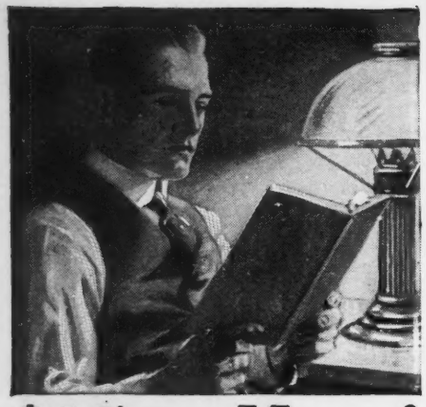

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Every mail brings letters from some of the thousands of I. C. S. students telling of promotions or increases in salary as the rewards of spare-time study.

What are you doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best. Yes, it will! Put it up to us to prove it.

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Without cost or obligation, please send me one of your booklets and tell me how I can qualify for the position or in the subject *before* which I have marked an X:

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Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

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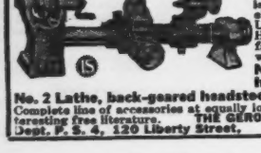
The Pillied Lumber Co., Swanton, Ohio

Amateur Mechanics—Model Makers—Students



Wade Bench-Lathe

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No. 2 Lathe, back-geared headstock - - - - $58.00

Complete line of accessories at equally low prices. Write for interesting free literature. THE GERALD COMPANY
Dept. P. S. 4, 120 Liberty Street, New York

Birth of the Airplane

(Continued from page 129)

had developed the other's hinged wings into the warping principle through the medium of a twisted box, so now he accepted and improved upon Orville's movable rudder. He said they should connect rudder and wings so as to warp and wag, as it were, simultaneously with one control. Within two days the brothers began to rig up a movable rudder connected by wires with the warping control. And at last they had the thrill of riding the air with a success unprecedented. Never before had man thus balanced himself in the atmosphere. Never had a glider behaved so tractably, responsive to its helm.

THERE were flights beyond 600 feet in 35-mile breezes. Within a fortnight the number of trips amounted to something around 700. Fore and aft balance had been rather easy from the start. Now that lateral balance and steerability had been secured, what remained? Only to equip the glider with engine and propeller.

The birth of the airplane should really be dated in October, 1902, instead of more than a year later when the first power flight occurred. That glider embodied all basic principles of air navigation.

Before leaving camp in the latter part of that October, the Wrights started plans for a power machine and also sketched an application for a patent. The patent was aimed to secure the honors of priority in a scientific achievement, for the brothers did not foresee commercial value in their invention.

During the following winter at home they built a crude four-cylinder gas engine. They designed it, had aluminum castings made in a local foundry, did the machining in their own shop. As evidence of crudity, it developed about 12 horsepower and weighed 20 pounds to the horsepower. The homemade engine let out such a tornado roar that scared neighbors rushed into the shop to see what was up, and the gas fumes sickened Charley Taylor, the sole and faithful employee of the Wrights.

IT WAS a harder job to design propellers, but after due mental wrestling, the brothers saw they could do it from the formulas of their air tables. They obtained a screw efficiency of 66 per cent, which was about a third better than any one before had realized. The wing span of the power biplane was 40 feet, its area 510 square feet, with 48 square feet more given to a duplex wing in front. The total weight of the machine, with either of the 145-pound brothers aboard (lying face down, hands on forward controls, hips harnessed for other work), was 750 pounds.

This is the pioneer machine that Orville Wright purposes to send to an English museum.

In March, 1903, nine months before this airplane took off at Kitty Hawk, the Wrights applied for a patent on their basic discoveries.

On the fourth sojourn in a sandy desert

(Continued on page 131)

ZIP-ZIP

LET'S GO BOYS

No matter where you go, camping, hunting, fishing, boating, to the country, the seashore or the mountains, you will need a Zip-Zip shooter. Thousands of boys are made happy with this wonderful Zip-Zip shooter. If your dealer happens not to have them order them from us. ZIP-ZIP shooter complete only 35c or three for $1.00 prepaid. Send stamps, coin or money order.

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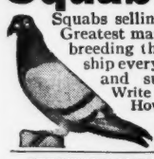

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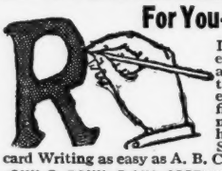

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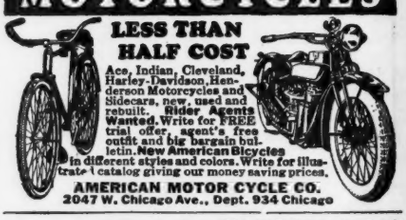

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Write for Catalog A—FREE

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Birth of the Airplane

(Continued from page 130)

within sight and sound of the thundering Atlantic, the inventors had many little adventures. These they recorded in home letters with comical appreciation, almost to the dwarfing of their high objective. There was a midnight battle with a tar-paper roof in a gale. Orville invented a French-drip coffee-pot to save the use of eggs. A carbide can was converted into a wood stove. As medical advice to Charley Taylor, who wrote from Dayton that he suffered from unsteady legs, Orville suggested bracing his legs with the truss system employed in his biplane.

AT THIS time Wilbur was 36 and Orville 32. Both were of slender, athletic build. The elder stood 5 feet 10¼ inches, or a trifle less than two inches above his brother. They were both smooth shaven and both had grayish blue eyes.

The propeller shafts twisted under strain of the first engine test at Kitty Hawk. In the next test the propeller sprockets came loose.

Things looked dark when a third accident—a bit of metal broken out of a new shaft—occurred in late November. Now the power machine was again helpless, before ever it had been tried in the air.

Four miles through deep sand, lugging two suitcases filled mostly with metal gear, hiked Orville to Kitty Hawk. He took a boat to Elizabeth City and then a northbound train. When he arrived in Dayton he hadn't five cents left for carfare. Weighted down with those suitcases, he walked 1½ miles to his home.

It took a week to obtain new shafts of spring steel, and Orville hustled back to Kitty Hawk with them. Thank heaven, the hoodoo was over. The power plant stood the Saturday test with engine aroar, screws speeding.

Wilbur was first of mankind to fly in a power machine, on Monday, December 14, three days before the official, accepted date for that event. To be sure, his time was but 3½ seconds and his distance 105 feet, and the hop ended in a partial wreck.

ORVILLE went up first on the commemorated December 17, 1903, remaining about 12 seconds in the air, but not much exceeding his brother's previous distance. Wilbur now followed in a similar flight. Orville had another turn of short duration. Then, just at noon, Wilbur stepped forward for the fourth and last flight.

It was a cold, dull day. Whitecaps were visible on the near-by Atlantic and ice was forming in Albemarle Sound. The aviators were chilly, having no special garments for their work. Doubtless the five spectators—three men of the government life-saving station, a lumber buyer, and a 16-year-old boy—were also cold and wished to have the affair over. Even the muse of history, we may imagine, got impatient and had to blow on her stylus-holding fingers to keep them warm.

Wilbur hastened to oblige. He covered a ground distance of 852 feet in 59 seconds, whereupon Clio said, "So that's that," and the meeting adjourned *sine die*.

MADE with absolute precision, the perfect balance of Marathon Tubes insures the best possible reception.

ALL that the name implies. In the orange-and-blue carton with the Marathon Runner. Every tube guaranteed.

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contains 900 mechanical movements; 40 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Special price (for a limited time) $1.00 postpaid. Albert E. Dieterich, 681-A Ouray Building, Washington. D. C.

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PACK the Smooth-On around the bolt, washer and on the threads, and the handle can never again come loose. Try the same trick on any loose tool, knife, or umbrella, handle, door knob, etc., and the result will surprise you.

Smooth-On No. 1 is also sure cure for leaks of water, steam, fire, etc., at cracks or breaks in metal. Just the thing for repairing radiators, heating boilers, furnaces, tanks, pipes, leaky pails, etc. Keep a can on hand for emergencies.

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At Last—
World's best typewriters with every modern writing feature at positively lowest prices and on easiest terms ever offered.

A Year to Pay—5 Years Guarantee
Standard Machines so perfectly Re-Manufactured by the exclusive Young Process that they look and write like brand new. Our exclusive, distinctive process makes possible better typewriters at lower prices.

FREE BIG ILLUSTRATED TYPEWRITER BOOK
Write now. See our amazing typewriter bargains. Read what users say and the unusual service we will give you. Don't wait. Write today.

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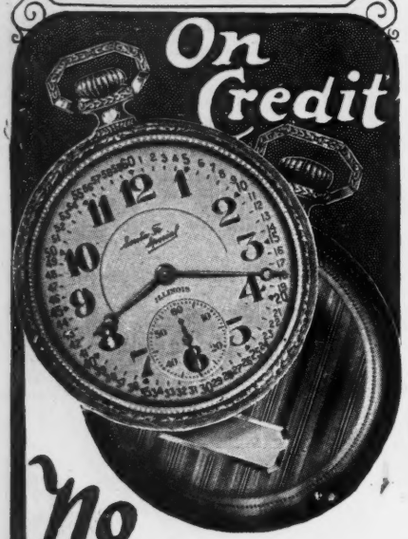
Santa Fe SPECIAL
On Credit



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We will send this famous watch direct to you, express prepaid on FREE approval. Examine watch and be convinced it's the best watch buy you ever saw. You save 1-3 to 1-2 your money by purchasing a Santa Fe Special Watch. We trust you—Wear watch while paying for it

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Clip the coupon, fill out and receive the FREE WATCH BOOK. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Select the watch you would like to see, we will send it to you on approval, express prepaid. Wear the watch 30 days FREE—return at our expense if not fully satisfied.
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Please send prepaid and without obligation, your Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

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Poisons in "Bootleg Booze"

(Continued from page 42)

public is disposed to resort to liquor of seemingly known and recent origin, under the impression that its local origin makes it safe and pure.

"The almost inconceivable conditions under which moonshine is manufactured are responsible largely for its dangerous character. The moonshiner has no scruples regarding the fate of the ultimate consumers. He has no conception of the proper facilities with which to work or the time needed for producing a drinkable product. He lets his mash ferment in unclean barrels, washtubs, and other similar receptacles, in dark, musty cellars, or in the open woods. Under such conditions the development of wild yeasts or unwholesome fermentations becomes inevitable. The vessels used become unspeakably filthy and ill-smelling after repeated use without cleaning, and the unprotected fermenting mixture attracts animal life of every description."

"The old-time distiller of the South would view with contempt the moonshiner of today," Linder added to the above. "This artist knew that he must discard the heads and tails of his distillation—the first and final 'runs' which passed through his still.

"THE moonshiner of today uses heads, tails, and everything, and sells it as it stands. He refuses to discard anything that makes volume. Poisons pay good profits.

"Another danger lies in the haste with which the stuff is placed on the market. Whisky should be allowed to age. In pre-prohibition days the aging process covered from one to eight years, while the liquor rested in wooden barrels with the insides charred.

"Sometimes an appearance of age is given by putting concentrated lye in the mash, to hasten fermentation. More than once government agents have found as high as 200 empty lye cans in a single place. Lye is very poisonous."

Extracts from reports of prohibition agents in various states shed considerable light on the almost unspeakable conditions under which liquor is manufactured.

"Moonshiners are dipping water from the North Canadian River," reports Director Millard F. Meadows, of Oklahoma, "below the point at which the city sewage is dumped into the stream. The water is used in souring the mash."

"Most of the whisky," reports Director Daily of that made in Mississippi, "is made from rotten grain, black strap molasses, shorts, chops, and the like. Old cans, tea-kettles, coffee-pots, and oil barrels are used as cookers. The insides of these vessels are unspeakably filthy. All kinds of bugs gather on the stinking stuff and finally drown in the spirits."

Texas, Colorado, and Minnesota sent in similar reports.

Near Homer, Ohio, raiders found a stock of whisky buried in stable manure, and the makers frankly stated that this was their method of aging their product.

These are merely a few extracts from reports selected at random from the government files. There are thousands of others.

It BURNS the Smoke

by mixing it with a supply of super-heated air (oxygen) over the fuel bed. That's why the

CROWN FUEL SAVER

is warranted to save at least 20% of your coal bill and often does much more. Successfully used for 10 years. We have just issued a detailed description of the Crown. If you are buying coal for consumption in a factory, store, residence, apartment building, school, church, theatre or greenhouse, write us today for proofs.

Splendid sales proposition for live distributors. Write—ask if your territory is open.

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Stop Using a Truss

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STUART'S PLAPAO-PADS are different from the truss, being mechanico-chemico applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or spring attached—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered. Soft as velvet—easy to apply—inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely FREE
Write name on Coupon and send TODAY.
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Return mail will bring Free Trial Plapao

SPORT BODIES $34.50 UP For Ford or Chevrolet

We can furnish you with the latest style roadster or racing body at prices that will surprise you. These bodies may be used with or without top or windshield or fenders, and may be underslung if desired.

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Dept. 1366 3601 Michigan Avenue, CHICAGO

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He Has Staged More Battles than Napoleon

(Continued from page 45)

bet that she doesn't mention how it happened. The stars earn their big salaries.

"Bravest of all of them are Gloria Swanson and Henry B. Walthall.

"In one picture it was my job—and incidentally it was the toughest job of my whole career—to blow an entire dirt trench over Walthall. That he was to be buried under 10 or 12 feet of earth didn't seem to worry him. 'Slim,' he said, 'can you do it?'

" 'Easy,' I replied, the cold shivers running up my spine.

" 'Then shoot!' said Walthall.

"The shot went off, and it took exactly six minutes for 10 men to dig Walthall out from under that pile of dirt. When they dragged him into the air once more, he was a little white around the gills and a little out of breath, but his 'Great work, Slim,' meant far more to me than the magnificent thrill the test pictures showed next day.

"AND Gloria Swanson—God bless her—is the gamest little woman I ever have known. No doubles for her in explosive scenes, nor temperament. She is just a great little trouper who wholeheartedly would eat a dozen sticks of dynamite if it were necessary for a scene."

A wood fire will not photograph, hence, it was one of Hoffman's jobs to concoct a chemical that would give every appearance of roaring flames. The remarkable part of it is that he found one that would burn without damage. Give him your finest piece of tapestry or antique furniture and he will set it all ablaze with this chemical, then return it to you unscratched. Or he can set a roomful of elaborate furnishings afire, let it burn a while, then extinguish the fire, and you cannot trace a single effect of the flames—even on the most delicate of wallpaper.

The mysterious chemical will flame just so long without burning. A second longer and the whole works is ruined. Consequently, this sort of shooting demands split-second timing on the part of both Hoffman and the cameraman.

Dynamite has the same sort of temperament as a tiger. It is docile for just so long, then, like the big cat, it is likely to do the unexpected. So it is not safe to lose respect for dynamite. It isn't a toy and men who handle dynamite daily as a business are very careful of their safety.

Has Hoffman ever been burned?

Yes. It happened the way all accidents occur.

LADY LUCK, like all women, is fickle. The moment a man deserts his chosen profession, Miss Fortune begins vamping him. Witness the lion-tamer who was poisoned by a pet kitten's scratch, and the steeple-jack who fell downstairs and broke his leg. Add to them Hoffman, who was asked to hold a lighting torch (a flare that lights scenes in night movies when electricity is not available). It exploded in his face and peeled off most of his skin. That Hoffman is with us today is due to a wealth of vitality and a pal who parted with great patches of skin.

$25.00 in Prizes
See top of page 10 in front of book for full details

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Switches off your "A" Battery and locks your set at the same time. "Off and On" name plate and key show position of switch at all times. Operates just like automobile Ignition Switch. Quarter turn, compact, single hole mounting. Carter quality and workmanship throughout. 3 keys furnished with each switch.

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Delivered on first payment of $5.50, then $1.00 a Week

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Stores in Leading Cities

RADIO FANS—Listen in on W. H. T. every Monday night from 7 to 7:30, every Friday night from 9:30 to 10, Central Standard Time. Loftis Bros. & Co.'s hour of music.

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A Pocket 66" Slide Rule

How would you like to own a slide rule 66" long? Here is its equivalent in pocket form.

The Otis King Patent Calculator has open spiral scales 66" long mounted on two metal tubes; yet when closed, it only measures 6 inches.

1650 divisions are marked on each of the scales—roughly five times the number on a 10" slide rule,—and results accurate to 5 or 5 significant figures are easily read with absolute certainty.

The instrument is practically indestructible, and the scales, being mounted on an all-metal body, cannot warp as so frequently happens with the slide rule. And instead of a delicate glass cursor there is a tubular indicator, which is good for a lifetime.

Send for this useful little instrument at once; after you have used it you wouldn't be without it for 10 times its cost. Price $5, exclusive of duty, but including carriage direct to your door.

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Otis King's Patent Pocket Calculator

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CONN BAND INSTRUMENTS
WORLD'S LARGEST MANUFACTURERS

How to Build a Wave Trap

(*Continued from page 74*)

causing most of the trouble.

If, on the other hand, several stations are interfering with the one you want to receive, the parallel connection may prove more useful; for when the wave trap is hooked up in this fashion, it is tuned to the station you want to receive and signals from all stations on other waves are cut down in strength.

It is desirable to mount the wave trap a foot or more from the receiver so that the magnetic coupling between the coils in the wave trap and the receiver will be at a minimum.

Tuning the wave trap is very simple. When it is connected in series, the receiver itself is tuned first to the wave of the interfering station, and then the dial on the wave trap is turned slowly until the signal disappears or is as weak as possible. Then the receiver is retuned to the wave of the desired station. Tuning the wave trap in the parallel connection is exactly the reverse. The desired station is first tuned in on the receiver and then the wave-trap dial is adjusted until the interfering signals are cut down as much as possible.

NOW for the adjustment of coil *A*. If you have too many turns in this coil when the wave trap is used in the series connection, the wave trap will be too effective; that is, it will cut down the signal strength of the station you want to receive, besides eliminating the undesired one.

In the parallel connection, on the other hand, too few turns make the wave trap very effective at the expense of the signal strength of the station you desire to receive, while a large number of turns in coil *A* reduces the effectiveness of the wave trap.

Recent Publications

Romance in Science, by Bessie I. Miller, Ph.D., professor of mathematics in Rockford College. A collection of lectures on various scientific topics.

Ancient Hunters and Their Modern Representatives, by W. J. Sollas, Sc.D., professor of Geology and Paleontology at Oxford University. Third edition of a popular work on archeology. Illustrated. The Macmillan Company.

The Story of Copper, by Watson Davis, C.E. An interesting, non-technical history of the first of the useful metals. The Century Co.

The Kinetic Theory of Gases, by Eugene Bloch. E. P. Dutton & Co.

The Planning, Erection and Operation of Modern Open Hearth Steel Works, by Hubert Hermanns. D. Van Nostrand Company.

The Elements of Machine Design, by S. J. Berard, Brown University, and E. O. Waters, Sheffield Scientific School (Yale). D. Van Nostrand Company.

Space and Time, by Carl Benedicks, formerly professor of physics at the University of Stockholm. Discussion of the ideas of space and time as developed by Einstein from an experimental physicist's standpoint. E. P. Dutton & Co.

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Here Are Correct Answers to Questions on Page 69

1. They are forced up by atmospheric pressure. When you suck on the straw, that makes a partial vacuum in your mouth and in the upper part of the straw. Instantly the pressure of the air outside forces some of the liquid into your mouth, just as it does with any kind of a suction pump.

2. To prevent the breaking of their ear drums. The part of the ear back of the drum communicates by means of a tube with the throat. If the mouth is open, the air wave from the fired gun goes in through the throat as well as into the ear. Its push against the outside of the drum will be neutralized by an equal push against the inside.

3. Several kinds are known. The commonest is made by dissolving a little cobalt chloride in water. This makes a light pink solution. Writing made with it is invisible so long as it is damp. When you heat it and dry it out, it turns blue and can be read. Let it stand a while and it will take up moisture again from the air, turn light pink and disappear. This may be repeated many times.

4. Nearly 1,600,000 miles; about 18½ miles a second.

5. The waves wear down the rocks and break them up. The fine dust that is produced is carried out to sea by the water and is deposited on the bottom, but the coarser particles stay on the beach and make the sand.

6. Places in which the sun is cooler and does not give out quite so much heat and light. They are believed to be caused by great whirling storms in the surface layers of the sun. Some of them are large enough for five or six spheres like the earth to be dropped inside the whirling center of the storm.

7. Hydrogen peroxide sets free an especially active kind of oxygen. This active oxygen combines chemically with the colored substances in the hair and turns them into other compounds that are colorless or light yellow.

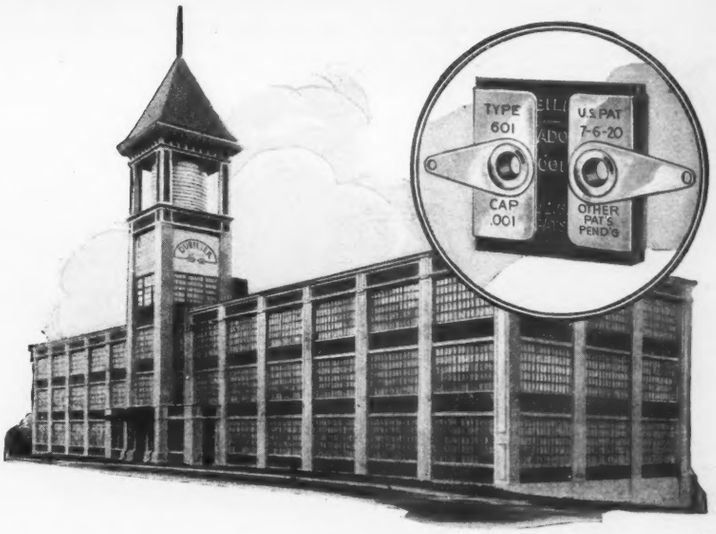
8. If there were any air inside the bulb the hot tungsten in the filament would combine with the oxygen of the air and burn up, just as a cotton thread would burn up in a hot furnace.

9. By means of a blanket of fat that almost entirely surrounds the body. It is this fat or blubber that provides much of the oil we get from whales.

10. Because it is only when it is hot that it emits the continual stream of electrons needed to operate the vacuum tube. This ability of hot metallic wires to emit electrons in a vacuum is what scientists call "thermionic emission."

11. A kind of eucalyptus, or blue-gum, which grows in Australia. Individual trees of this species have been known to grow 400 feet tall.

12. This is another effect of the chemical discharged by your adrenal glands. This chemical makes all the tiny blood vessels in the skin and in the surface layers of the body contract so that most of the blood is squeezed out of them. Of course, this has the effect of making your face seem whiter.



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